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October 15, 1990

Energy Research Abstracts

Abstracts 42321–43650

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of nonreport literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for online searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire database is available through commercial online vendors.

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ERA is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO Stock Number is 061-000-00749-1 for the Volume 14 indexes.

Managing Editor, Audrey B. Smith
Technical Editor, Robert W. Rutkowski

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
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6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
10. **Date of publication.** If not known, a processing date is in brackets.
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16. **Contract or grant number.**
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18. **Conference title, location, and date,** if applicable.
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20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. **Wisconsin** Univ., Madison (USA). **Dept. of Physics.** [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. **Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.**

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

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Books, conferences, and monographs The source for these publications is the publisher or the originating society, organization, or institution. DOE-supported conferences and individual papers reporting DOE-supported research may be available as reports from OSTI.

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Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

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TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

0103 Preparation

42321 (STEV-TORV–90-6) **Characterization of the dewatering properties of fuel peat.** Muenter, M. (Chalmers Univ. of Tech., Goeteborg (SE). Dept. of Chemical Engineering Design); Andersson, H.K. Statens Energiverk, Stockholm (Sweden). 1987. 145p. (In Swedish, English). Project STEV-146-087. Order Number DE90512614. Source: NTIS (US Sales Only), PC A07/MF A01.

The aim of the project was to find a relation between dewatering results and the results from the characterization analysis. As means for characterization were used compressiblity and permeability determinations. In addition was the particle size distribution of the peat determined. The studies were done with both treated and untreated peat. The treatments used were plymer addition, solvent addition, pressure treatment, and wet carbonization. The dewatering results show that raw peat should be diluted as little as possible before treatment with i.e. poly-electrolytes, a relation that also holds for wet carbonization. Accordingly wet carbonization should be done a high solids content, both to attain the high soilds content and to yield low operation costs. (44 figs., 10 tabs., 13 refs.).

0104 Processing

Refer also to citation(s) 42372, 43039

42322 (CONF-9007133–1) **Analysis of pipe failure for the Great Plains Coal Gasification Plant.** Keiser, J.R. (Oak Ridge National Lab., TN (USA)); Mayotte, J.R.; Dias, O.C. Oak Ridge National Lab., TN (USA). [1990]. 16p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 23. international metallographic society annual convention; Cincinnati, OH (USA); 22-25 Jul 1990. Order Number DE90014192. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The rupture of a carbon steel elbow in the methanation area of the Great Plains Coal Gasification Plant resulted in a fire and plant shutdown. The failure was investigated by personnel from Oak Ridge National Laboratory and ANG Associates, the plant operators. These studies consisted of an on-site inspection and extensive laboratory examination that included optical metallography, x-ray fluorescence, x-ray diffraction, chemical analyses, and electron spectroscopy for chemical analysis (ESCA). It was concluded that operation of a heat exchanger under off-specification conditions contributed to higher than design temperatures, lower than design pressures, and higher than design concentrations of carbon dioxide and water in the exit line from a condensate separator. Together, these conditions produced high levels of carbonic acid and higher than design velocities resulting in severe corrosion of the carbon steel. 9 refs., 7 figs., 2 tabs.

42323 (DOE/ER/13814–2) **Direct alcohol synthesis using modified cobalt catalysts: Final report.** Griffin, G.L. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Chemical Engineering. 18 Jun 1990. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13814. Order Number DE90014626. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have investigated factors affecting methanol and higher alcohol synthesis using mixed copper/cobalt based catalysts. We studied coprecipitated Cu/Co/Zr/Al/K catalysts in our preliminary studies. We prepared mixed oxide precursors and Cu/Co/Cr/K catalysts by the complexation method. We studied the effects of CO_2/CO and H_2/CO ratios and catalyst composition on the activities and the alcohol selectivities of Cu/Co/Cr/K catalysts. CO_2 in the feed gas inhibited activity and alcohol selectivity of unpromoted Cu/Cr and Cu/Co/Cr catalysts but did not affect the hydrocarbon yield. Decreasing H_2CO ratio decreased the activity of unpromoted Cu/Cr and Cu/Co/Cr catalysts but increased the alcohol yield of Cu/Co/Cr catalysts. Feed gas composition had little effect on the activity and selectivity of Cu/Cr/K catalyst. Increasing the Co content in the catalyst resulted in a decrease in catalyst activity and alcohol selectivity and an increase in hydrocarbon selectivity. K inhibited the activity and alcohol selectivity of Cu/Cr catalysts in the presence of a CO_2-free feed gas whereas K promoted the alcohol selectivity of Cu/Co/Cr catalysts. We developed an oxide coverage model to account for the effect of K and CO_2 on the methanol synthesis rate. We proposed a unified model for active sites in Cu/Co/Cr/K catalysts. 58 refs.

42324 (DOE/PC/79926–9) **Kinetics of coal conversion to soluble products: Quarterly report, January 1, 1990–March 31, 1990.** Yamada, O.; Azik, M.; Larsen, J.W. Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry. 27 Apr 1990. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79926. Order Number DE90015383. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of this work are: (1) to measure the kinetics of the conversion of coals to soluble products under model liquefaction conditions using gel permeation chromatography (GPC) techniques to count the number of bonds broken; and (2) to analyze these data using kinetic schemes based on the behavior of crosslinked macromolecular networks. This quarter, the molecular weight distribution of soluble products of coals and their pyridine-soluble (PS) and pyridine-insoluble (PI) portions has been measured by a successfully tested computer-interfaced GPC with a mass sensitive detector which requires 0.5 mg of sample. Liquefaction experiments were run using tetralin and coal (Illinois No. 6 or Pittsburgh No. 8) and separately with its pyridine-insoluble and pyridine-soluble portions. 5 refs., 1 fig., 2 tabs.

42325 (DOE/PC/79926–10) **Kinetics of coal conversion to soluble products: Quarterly report, April 1, 1990–June 30, 1990.** Azik, M.; Larsen, J.W. Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry. 31 Jul 1990. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79926. Order Number DE90015384. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of the proposed work are: (1) to reduce to practice a new kinetic technique and data analysis methods providing more fundamental insight into coal conversion processes and (2) to use the technique to gain increased understanding of coal conversion under commonly used reaction conditions. In this period, we attempted to measure the molecular weight distribution of Illinois #6 and Rawhide extracts dissolved in pyridine by PDMS using a Bioion-20 time-of-flight spectrometer. The mass spectra obtained from the extracts are considerably more complicated than those obtained from biological materials. Therefore, we developed a software package that can be executed with any IBM compatable PC to determine the number average and weight average molecular weights. In addition, this software package allows us to subtract the background which comes from solvent and mylar. In order to test the reproducibility of this system, we obtained the mass spectra of Rawhide coal extract five times and each spectrum has been subtracted from the first. 6 refs., 2 figs.

42326 (DOE/PC/88927–8) **Mechanistic and kinetic studies of high-temperature coal gas desulfurization sorbents: Quarterly technical progress report No. 8, April–June 1990.** Lew, S.; Flytzani-Stephanopoulos, M.; Sarofim, A.F. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemical Engineering. Jul 1990. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88927. Order Number DE90015368. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress continued on coal gas desulfurization. During the previous quarter, changes in the surface area of the sorbents after sulfidation were discussed. Further experiments were performed in this area to elucidate the role of TiO_2 in inhibiting sintering. In addition, the effect of hydrogen on sulfidation was examined. In a previous report, it was reported that the presence of hydrogen had

only a small effect on the sulfidation profile. Sulfidation was performed at a higher temperature (800 C) with various hydrogen concentrations to determine whether any noticeable difference in sulfidation profiles of ZnO and Zn–Ti–O sorbents under more reducing conditions is present. Major findings reported this quarter are: the surface area of the sulfided sorbents increased as the relative amount of TiO_2 increased from 25 mol % to 50 mol %; at 800 C, no zinc loss was present during reaction in a reducing sulfidation gas of either ZnO or Z2T-a; SEM micrographs of ZnO sulfided with 2% H_2S-H_2-bal. N_2 at 800 C show a large difference when various amounts (1, 10, and 20 mol % H_2) of hydrogen were added to the gas. Cracks and fissures formed by the evolution of Zn(g) and H_2O(g) were found in ZnO sulfided in 10 and 20 mol % H_2. Agglomerates of ZnS due to the gas phase sulfidation of Zn(g) were also present; and SEM micrographs of Z2T sulfided in various amounts of H_2 show no gross morphological changes at 800 C. 4 refs., 10 figs., 4 tabs.

42327 (ORNL–6617) **Fossil Energy Program semiannual progress report for April through September 1989.** Judkins, R.R. Oak Ridge National Lab., TN (USA). Apr 1990. 155p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE90014757. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report covers progress made during the period April 1 through September 30, 1989, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by the DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, and the Tennessee Valley Authority. Projects are discussed concerning the following subjects: materials research and development; environmental analysis and information systems; coal conversion development; fossil fuels supply models; fluidized bed combustion programs; support to the strategic petroleum reserve program; and coal structure and chemistry. References, figures, and tables are included in each section.

42328 (SAND–90-7021C) **Integrating coal cleaning and pyrolysis with two-stage direct coal liquefaction: Assessment of technical and economic potential.** Gray, D. (Mitre Corp., McLean, VA (USA)); Tomlinson, G.C.; Wan, E.; Moran, D.; Karlson, F.; Parsons, T. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. (CONF-900958–1: 7. annual international Pittsburgh coal conference, Pittsburgh, PA (USA), 10-14 Sep 1990). Order Number DE90015001. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper documents the results of a study that has investigated the integration of coal cleaning and coal pyrolysis with two-stage direct coal liquefaction. Both conventional coal cleaning and combinations of conventional coal cleaning and oil agglomeration have been investigated. The results of the coal cleaning/liquefaction integration analysis indicate that the lowest cost configuration is the case where differential coal cleaning is used to produce a low-ash feed containing 4.7 percent ash for liquefaction and a high-ash middlings containing 25 percent ash for gasification. The integration of coal liquefaction and pyrolysis indicates that there is a potential savings in the cost of coal liquids by eliminating the critical solvent deasher as the solids/liquids separation process and using the pyrolysis unit to process vacuum bottoms from liquefaction. 4 refs.

42329 (STEV-FGT–90-2, pp. 3:1-30) **H_2S separation at high temperatures by means of calcium absorbents.** Forkman, M. (Lund Univ. (SE). Dept. of Chemical Engineering 2). Statens Energiverk, Stockholm (Sweden). Nov 1989. (In Swedish). Project STEV-136-026. In *Bio-gasification LTH. Final report, step 7.* Order Number DE90512648. Source: NTIS (US Sales Only), PC A05/MF A01.

It has been established that: * It would be advantageous if desulphurization of combustible gases could be made at high temperatures. * It is desirable to be able to regenerate the absorbent, and recover the sulphur from the gas. * Hydrogen-sulphide is usually the most abundant and the most stable sulphur compound in several industrial processes. * Dolomite is far superior to limestone as H_2S-absorbent. * A suitable temperature for absorption of H_2S with dolomite is between 700 and 900 degrees centigrade. At such temperatures a high degree of absorption is reached. * Dolomite can be regenerated as a H_2S-absorbent. In doing so commercially attractive amounts of H_2S or SO_2 are released. * The regeneration can be done either at high temperatures or at high pressures. * The decomposition of H_2S in hydrogen and elemental sulphur is extensive at high temperatures. * The concentration of H_2S in the gas out from a bed of dolomite, sinks significantly when the bed temperature is raised from 600 to 800 deg C. * The concentration of H_2S in the gas out from a bed of dolomite sinks, when the residual time in the bed is raised from 1 to 1.4 seconds. (orig.) (17 figs., 3 tabs., 20 refs.).

42330 Microbial solubilization of coal. Strandberg, G.W.; Lewis, S.N. To Dept. of Energy, Washington, DC. USA Patent 4914024/A/. 3 Apr 1990. Filed date 21 Jan 1988. USA Patent Application 7-146,622. Int. Cl. C12P 1/00. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This invention deals with the solubilization of coal using species of Streptomyces. Also disclosed is an extracellular component from a species of Streptomyces, the component being able to solubilize coal.

0106 Properties and Composition

Refer also to citation(s) 42327, 42927

42331 (INCT–2052/5/PS/B) **Methodology of diffraction studies on laminar amorphous structures at the early stage of their formation in the case of coals.** Grigoriew, H. Institute of Nuclear Chemistry and Technology, Warsaw (Poland). 1987. 60p. (In Polish). Order Number DE90634521. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

A method of interpretation of RDF (radial distribution function) results has been elaborated for laminar amorphous structures using models, verified by matching the experimental and model distribution functions of pair of atoms P(r). It has been found that by means of this method it is possible to determine some structural properties as layer dimensions, stack formation and various hybridizations of atoms. It appears that the P(r) functions depend on the shape of layers and the initial stages of stack formation. An experimental RDF method has been developed in order to obtain the most reliable results of the X-ray examinations of low atomic number materials. In order to verify these methods, the petrographic components of coals and carbon-film have been investigated. Some representative models have been proposed for the structures of the materials studied. Contrary to the current opinions it has been shown that the atomic layers in the materials under examination are relatively large, their space arrangements being mostly stacks. The developed methods can be applied to examination of various laminar materials with amorphous structures with small degree of ordering. 61 refs., 18 figs., 3 tabs. (author).

0108 Waste Management

Refer also to citation(s) 42660, 42661, 42931

42332 (DOE/METC–90/6110) **Proceedings of the seventh annual coal-fueled heat engines and gas stream cleanup systems contractors review meeting.** Webb, H.A.; Rekos, N.F.; Kothari, V.P.; Bedick, R.C. (eds.). USDOE Morgantown Energy Technology Center, WV (USA). Mar 1990. 470p. Sponsored by U.S. DOE Fossil Energy. (CONF-900381–: 7. annual coal-fueled heat engines and gas stream cleanup systems contractors review meeting, Morgantown, WV (USA), 26-28 Mar 1990). Order Number DE90000480. Source: NTIS, PC A20/MF A01 - OSTI; GPO Dep.

The seventh Annual Coal-Fueled Heat Engines and Gas Stream Cleanup Systems Contractors Review Meeting was held March 26–28, 1990, at the Lakeview Resort and Conference Center in Morgantown, West Virginia. This meeting was sponsored and hosted by the Morgantown Energy Technology Center of the US Department of Energy. The purpose of this annual meeting is to provide an opportunity for scientists and engineers working in heat engines and gas stream cleanup technologies to present their research results, exchange ideas, and discuss their future plans. About 300 attendees from industry, academia, and Government

participated in this 3-day meeting. Almost 60 papers and poster presentations were given on the following topics: proof of concept, systems assessment; advanced coal-fueled gas turbine systems; gas stream cleanup, two sessions; panel discussion: turbine emissions; panel discussion: diesel emissions; panel discussion: low cost fuels; and poster presentations. Individual projects were processed separately for the data bases.

42333 (IEACR–25) **Pollution control for industrial coal-fired boilers.** Vernon, J.L. IEA Coal Research, London (UK). ©Jul 1990. 44p. Sponsored by International Energy Agency. Source: IEA Coal Research, 10-18 Putney Hill, London SW15 6AA, United Kingdom.

This report examines the pollution control requirements placed on industrial coal-fired plants, reviews the technologies available for meeting these requirements, and evaluates their impacts on the costs of industrial energy from coal. The study focuses on coal-fired boilers for steam and hot water, excluding large-scale power generation units, steel works and cement kilns, and domestic boilers. Most boilers covered by the study lie in the range 0.5–50 MWt. Particular attention is given to the difference in control approaches and costs between industrial and electricity generation boilers firing coal. Approaches which can control a range of pollutants simultaneously, with maximum cost-effectiveness, are emphasized. Although coal-fired industrial boilers currently produce only a small proportion of pollution from coal firing, they are becoming subject to increasingly stringent environmental regulations. Industrial boilers have the advantage of using technologies such as stoker firing and FBC which produce relatively low emissions of pollutants, but as many industrial boilers are small they are unable to benefit from economies of scale and operators may have fewer resources available for investment in pollution control. 73 refs., 3 figs., 19 tabs.

42334 **In-situ desulfurization in a fluidized-bed coal gasifier.** Goyal, A. (Institute of Gas Technology, Chicago, IL (USA)); Bryan, B.G.; Rehmat, A.; Patel, J.G.; Ghate, M.R. *Energy Sources (New York) (USA)*, 12(2): 161-179 (1990). DOE Contract AC21-85MC22061.

A high-pressure coal gasification process development unit (PDU) has been used to study in-situ desulfurization in an ash-agglomerating, fluidized-bed coal gasifier at elevated pressures. This work extends this pressure range to 400 psig, well within the pressure range of the combustion turbines now being considered for application in integrated gasification combined cycle (IGCC) power plants. The coal used in this study was Pittsburgh No. 8 bituminous coal, and the sorbent used was New Enterprise limestone. Data were collected and analyzed to determine the effects of gasifier pressure and temperature on sulfur capture within the fluidized bed. The optimum temperature for maximum sulfur removal was determined as a function of the partial pressure of CO_2 in the fluidized bed.

0120 Mining

Refer also to citation(s) 42379

42335 (DOE/FE/00016–T178) **Evaluate fundamental approaches to longwall dust control: Subprogram G, Reduction of shield generated dust: Final report.** Mangolds, A.; Rajan, S.; Ruggieri, S. Foster-Miller, Inc., Waltham, MA (USA). May 1990. 50p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AI01-81FE00016. Contract J0318097. Order Number DE90015496. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As longwall shield supports have become more popular and shearer-generated dust has been reduced, many mines have noticed that support movement can be a significant respirable dust contributor. The objective of this program was to isolate and document the mechanics of support dust generation and mobilization and to devise appropriate control techniques. This was accomplished through a literature review, laboratory testing and underground surveys. The literature review studied past research related to support dust generation and existing control measures. Laboratory testing investigated a variety of ventilation factors such as canopy cross flow, eddy effects and the effectiveness of canopy sprays. Airflow over and around advancing shields was shown to be a significant factor in dust dispersion, and spray systems indicated promise for control. The underground surveys provided additional insight into the patterns of shield dust generation and dispersion, and confirmed that shield dust can be a significant fraction of workers' dust exposures. 17 figs., 3 tabs.

42336 (DOE/FE/00016–T179) **Evaluate fundamental approaches to longwall dust control: Subprogram H, Air canopies for longwalls: Final report.** Rajan, S.; Ruggieri, S.K. Foster-Miller, Inc., Waltham, MA (USA). May 1990. 34p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AI01-81FE00016. Order Number DE90015319. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes the laboratory development and evaluation of an air canopy concept for longwall faces. The objective in an underground application would be to create a clean air zone along the face walkway by equipping the shields with water-powered scrubbers or other devices. Contaminated air would be extracted, cleaned and reinjected into the breathing zone of face personnel. The concept was evaluated in a full scale longwall test facility by equipping alternate shields with simulated air canopies. A variety of canopy configurations and airflow capacities were tested under different face ventilation situations to determine the quality and extent of the clean air zone developed by the canopy. The results revealed that even the most optimum configurations were unable to create a suitable clean air zone. Low effectiveness, coupled with high projected costs for underground application, showed the concept to be unfeasible and further development effort was cancelled. 21 figs.

0130 Transport, Handling, and Storage

Refer also to citation(s) 42929

42337 (SV-UL–90-16) **Pumping of peat slurry: A literature survey.** Liljekvist, J.O. Swedish State Power Board, Aelvkarleby (Sweden). 1 Feb 1990. 42p. (In Swedish). Order Number DE90512645. Source: NTIS (US Sales Only), PC A03/MF A01.

Pumping of peat has been studied chiefly in Canada, Finland, Sweden, and the Soviet Union. Pumping of peat slurry has been applied at production plants i.a. in the Soviet Union and Canada. In the Soviet Union pumping was used in the so-called Hydro-peat method and in Canada in connection with wet digging and transport of peat for production of soil conditioner peat. These plants are now shut down. Several investigations on peat slurry pumping are reported in literature. Tests have been made both in laboratory scale with pipe diameters of 15-50 mm, and in semi-technical scale up to ca 400 mm diameter. Pipe flow resistance and viscosity of peat slurry has been measured and conclusions for pressure drop estimations have been worked out. These conclusions are however valid only under particular conditions and cannot be applied from a general point of view. In addition to flow technology parameters like pipe diameters and velocity also the specific properties of the peat will influence the flow resistance; properties like kind of peat, degree of humification, slurry concentration, chemical and physical composition. The peat treatment before pump transportation has also a great influence on the flow conditions and by that on the resistance. In some cases, by high concentrations, plug flow may occur. Correlations between flow resistance, solids, and flow rate for various kinds of peat have been experimentally developed by VTT, Finland, and shown in the form of diagrams. Examples are given in an appendix to the report. To obtain a reliable bases of dimensioning of pumping plants for peat slurry practical measurements should be done for each particular case where the peat kind in question and working of the peat is investigated in production engineering scale. (28 figs., 21 refs.).

0140 Combustion

Refer also to citation(s) 42327, 42662, 42925, 42926, 42928, 42930

42338 (DOE/PC/70815–T13-Pt.2-Vol.2) **Kinetics of coal combustion: Part 2, Mechanisms and kinetics of coal volatiles combustion: Volume 2: Final report, October 1984–September 1988.** Essenhigh, R.H. (Ohio State Univ., Columbus, OH (USA));

Bailey, E.G.; Shaw, D.W. TRW Space and Technology Group, Redondo Beach, CA (USA); California Inst. of Tech., Pasadena, CA (USA); Ohio State Univ., Columbus, OH (USA). Dec 1988. 136p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-84PC70815. Order Number DE90014420. Source: NTIS, PC A07/MF A01 - OSTI.

Values of global kinetic constants for the combustion of coal volatiles have been determined for the first time for volatiles from three coals (two bituminous coals and a Texas lignite). Global kinetic constants for methane and propane were also measured in the same apparatus to allow comparison with reference gases. Comparisons have also been made with values of global kinetics for pure hydrocarbons from a range of experiments as found in the literature. The volatiles were pyrolyzed from crushed coal drawn on weighed trays through a gas-fired muffle furnace, and they were burned at the top of a tube in an intense back-mix volume treated theoretically as a stirred reactor. Two types of experiment were carried out: partial combustion measurements near the stoichiometric for all coals from which the global kinetics were determined; and extinction limits for the Pittsburgh #8 coal volatiles to determine the extinction loop. The near stoichiometric generated kinetic data were used to predict the extinction limits with substantial agreement. Extinction loops for methane, propane and carbon monoxide were also measured for comparison.

42339 (DOE/PC/79906–T3) **Laser diagnostics of mineral matter and combustion processes in coal: Final project report.** Venkateswarlu, P.; Subba Rao, V.; George, M.C. Alabama A and M Univ., Normal, AL (USA). Dept. of Physics. Dec 1989. 66p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79906. Order Number DE90013947. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The main purpose of this project is to study the role of mineral matter in coal combustion using laser-spectroscopic techniques. However, it is necessary, as discussed in the proposal, to carry out conventional analysis of coal to obtain information about the nature of volatile matter and of the mineral matter. We analyzed the volatile matter generated by heating coal in vacuum using a quadrupole mass spectrometer. We then carried out an analysis of ash generated by oxidizing coal in air at 400–500°C in a muffle furnace. The analysis was carried out using an atomic absorption spectrophotometer. In order to obtain a precise analysis of the flame constituents, the spectra of the laser induced combustion of coal (coal flame) were recorded. With a view to characterize the mineral constituents present in the flame, a laboratory furnace was fabricated to burn coal at low pressures and obtain optogalvanic spectra of various species as a function of position in the flame. Results are discussed. 5 refs., 5 figs., 5 tabs.

42340 (RISO-M–2839) **Test and verification of laser techniques in a pulverized coal boiler.** Clausen, S.; Jensen, P.A.; Rathmann, O. Risoe National Lab., Roskilde (Denmark). Energy Technology. Feb 1990. 81p. (In Danish). Contract EM-1433/86-16. Order Number DE90509412. Source: NTIS (US Sales Only), PC A05/MF A01; Also available from Risoe Library, DK-4000 Roskilde. EFP-86.

The project is the first in Denmark, where laser techniques are used in diagnostics of a semi scale pulverized coal combustor. The light scattering of spherical absorbing particles have been studied theoretically. Back, forward and off-axis scattered detector signals, Doppler bursts, have been calculated based on Mie scattering. The experimental furnace used 1.2 m in diameter and 4.5 m long. The maximum input power is 1.5 MW. In the reported laser measurements the power was set to 490 kW. The furnace have been specially designed for laser measurements with measuring ports for detection of the forward scattered light. Heat transport to the 11 sections of the furnace, temperatures, gas composition, air and coal flows where logged on computer. Local axial and tangential mean and RMS velocities were measured throughout the furnace with a laser Doppler anemometer (LDA) for an isothermal and a coal combustion case. Laser Doppler measurements were problematic in the center of the first 300 mm of the coal flame, the hard zone of the near burner field, because of the high coal concentrations. (author) 2 tabs., 51 ills., 33 refs.

42341 (TUD-MEMT–9, pp. 5.1-5.9, Paper 5) **Pressurized fluidized bed combustion.** Boersma, D. (Delft Univ. of Technology (Netherlands). Lab. for Thermal Power Engineering); Andries, J.; Hein, K.R.G. Laboratory for Thermal Power Engineering, Delft (Netherlands). Apr 1990. In *Process and energy in the environment.* Order Number DE90509331. Source: NTIS (US Sales Only), PC A06/MF A01.

Pressurized fluidized bed combustion as a low pollutant combustion technique of coal for large scale electricity generation has been a research topic of the Laboratory for Thermal Power Generation for several years. The design of a research furnace was restricted by financial and technical limitations but the present Delft sub pilot scale test facility offers good possibilities for research on realistic coal burning problems. Freeboard phenomena are considered of major importance. The difference between two typical coals under pressures up to 0.8 MPa with respect to the presence of nitrogen oxides in the flue gas is demonstrated. The combustor is used as an hot gas generator for high pressure high temperature gas cleaning research. 5 figs., 4 refs., 1 tab.

42342 Symposium (International) on Combustion, 22nd, University of Washington, Seattle, Aug. 14-19, 1988, Proceedings. 2099p. Combustion Institute, Pittsburgh, PA (US) (1989). (CONF-880802–: 22. international symposium on combustion, Seattle, WA (USA), 14-19 Aug 1988).

Papers on combustion are presented, including papers on coal combustion, combustion-generated particulates, engine combustion, turbulent combustion, reaction kinetics, combustion-generated NO(x) and SO(x), fires, fire characterization, laminar flames, ignition and extinction, detonations and explosions, dust combustion, propellants, combustion diagnostics, and multiphase combustion. Specific topics include soot formation in diffusion flames of fuel/oxygen mixtures, sooting limits of aerodynamically-strained diffusion flames, premixed combustion in a vortex, the structure of a laminar nonpremixed flame in an unsteady vortical flow, and a model gas turbine combustor with wall jets and optical access for turbulent mixing, fuel effects, and spray studies. Additional topics include the role of the recirculation vortex in improving fuel-air mixing within swirling flames, fractal geometry applications in turbulent combustion data analysis, a simulation with a cellular automaton for turbulent combustion modeling, turbulent combustion in nonpremixed flames, the structure of premixed turbulent flames, lifted turbulent jet flames, chemical kinetic modeling and sensitivity analyses for boron-assisted hydrocarbon combustion, the driving force of PAH production, and the near-limit flame spread over a thin solid fuel in microgravity.

42343 An investigation of pulse-combustor design for slurry atomization. Morris, G.J. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US)); Welter, M.J.; Richards, G.A. pp. 35-42 of Proceedings of the fossil fuel combustion symposium 1990: Volume 30. Singh, S.N. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

A unique pulse combustor design is described that produces large amplitude pressure oscillations and tailpipe velocities for the intended purpose of atomizing liquid-solid slurry mixtures. Pressure amplitudes as high as 280 kPa were observed at a frequency near 20 Hz. Investigation of the combustor performance was reported as a function of equivalence ratio, mean throughput, and tailpipe geometry. In addition, the combustor wall temperature was shown to be very significant in determining the peak pressure and frequency. Analyses of frequency and pressure data implied that oscillations were controlled by a competition between cyclic heat losses and energy input from a continuous spark source. At the conditions studied, lower combustor throughputs were shown to result in higher frequencies without appreciable reduction in pressure amplitude. Thus, low combustor fuel throughput may be effective in producing high-velocity exhaust stream for atomization purposes.

0160 Health and Safety

Refer also to citation(s) 42335, 42336

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 42327, 42645

42344 (DOE/BC/14403–T3) **Characterization of oil and gas reservoir heterogeneity: Fifth quarterly report, April 15–June 30, 1990.** Texas Office of the Governor, Austin, TX (USA). [1990]. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14403. Order Number DE90014476. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Progress in the fifth quarter of research funded under the auspices of MOU Annex 1 is summarized with respect to seven main subtask areas. These subtask areas with (1) definition of the distribution of carbonate sandbar facies for Grayburg reservoirs; (2) definition of three-dimensional geometry of carbonate sand bodies; (3) analysis of engineering and petrophysical attributes of reservoir flow units; (4) development and testing of extended conventional oil recovery strategies; (5) characterization of gas reservoirs; (6) geologic and engineering characterization of generic gas reservoir types; and (7) refinement of exploitation strategies. Key areas of progress for the fifth quarter concern subtasks 1, 2, 3, and 6. 2 figs.

42345 (DOE/EIA–0523(90/1Q)) **International oil and gas exploration and development activities: Quarterly report, January–March 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 26 Jul 1990. 51p. Sponsored by U.S. DOE Management & Administration. Order Number DE90015076. Source: NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report is part of an ongoing series of quarterly publications that monitors discoveries of oil and natural gas in foreign countries and provides an analysis of the reserve additions that result. The report is prepared by the Energy Information Administration (EIA) of the US Department of Energy (DOE) under the Foreign Energy Supply Assessment Program (FESAP). It presents a summary of discoveries and reserve additions that result from international exploration and development, implementation, and evaluation of energy plans, policy and legislation. A discovery, as used in this publication, is a published estimate of the ultimately recoverable reserves for either a new field, reservoir, or well. This ultimate recovery is defined in this report as cumulative production plus remaining reserves. These discoveries are obtainable from various oil industry periodicals and company annual or quarterly reports. The discoveries are not verified by EIA but simply restated in this publication. The reported reserves do not necessarily follow the EIA definition of proved reserves. Each reserve entry follows the defining criteria of the originator. Not all discoveries are announced and not all announced discoveries are published. Some discoveries may be exaggerated or understand for political or other reasons. Therefore, the data in this report should be used with caution. 23 refs., 8 figs., 4 tabs.

42346 (IKU-R–33.0298.00/02/89) **Stress history effects on petrophysical properties of granular rocks.** Rathore, J.S.; Holt, R.M.; Fjaer, E.; Rendall, H. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). May 1989. 70p. Order Number DE90512580. Source: NTIS (US Sales Only), PC A04/MF A01.

Knowledge of the in-situ stress field is of major importance in many petroleum applications. Routine measurements on cores are used to estimate stress directions and, at times, magnitudes. It is feasible, however, that the total stress history of the rock, together with its inherent rock fabric, and not only the rapid unloading during coring, may influence these measurements. The synergistic study, of a variety of petrophysical parameters, reported here is an attempt to resolve the influence of the stress history on the studied rock parameters. Synthetic sandstones have been formed under anisotropic stress conditions. Anisotropies in acoustic (p- and s-wave) velocities, magnetic susceptibility, permeability and rock strengths have been measured on the unloaded synthetics. The rock porosities and thin section structures have also been studied. The measured petrophysical parameters, and in particular their anisotropies have been correlated with the preset stress conditions of the synthetics. The consequences of these laboratory experiments for analysis of field cores are discussed and exampled. 17 refs., 39 figs., 15 tabs.

42347 (UCRL-LR–103670) **Non-OPEC oil production: The key to the future.** Borg, I.Y. Lawrence Livermore National Lab., CA (USA). 11 May 1990. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. Order Number DE90014796. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The dramatic increase in non-OPEC oil production that has occurred since the fuel crises of the seventies was accelerated by the subsequent increases in oil prices on world markets. Current moderate world prices are attributable to increased supply in the last decade from these countries. Among those nations whose production has more than doubled since 1973 are China, Mexico, the UK, Norway, Egypt, India, Oman, Brazil, Colombia, Angola, and Syria. In this context, non-OPEC nations include the Communist oil-producing countries, since their ability to meet their own domestic demand has forestalled the day when they will compete for supplies on world markets. The prospect for continued growth in non-OPEC oil production is good. Prospects for additions to reserves continue to be bright in virgin exploration areas and semi-mature oil-producing provinces. Non-OPEC oil production may reach peak levels in the 1995–2000 time frame. However, production will be increasingly countered by growing demand, especially in South and Central America and Asia. It is almost certain that by the mid-nineties, competition for oil supplies in world markets will elevate the price of oil available from the well endowed OPEC nations. Supply disruptions as well may be in the offing by the turn of the century as surpluses on world markets disappear. 92 refs., 20 figs., 5 tabs.

0203 Drilling and Production

42348 (AEEW-M–2564) **The effect of flow rate on the gelation of xanthan/chromium mixtures.** Johnston, J.D.; Hubbard, S. UKAEA Atomic Energy Establishment, Winfrith (UK). Chemistry Div. Nov 1989. 34p. Order Number DE90512668. Source: NTIS (US Sales Only), PC A03/MF A01.

Two injections of gelling xanthan/chromium (III) mixtures into Clashach sandstone have been performed in order to investigate the flow rate dependence of the gelation reaction. In the first dynamic experiment the frontal advance rate was 1.5 feet per day, and in the second experiment the flow rate was reduced gradually from 1.5 feet per day to a minimum of 0.7 $ft.d^{-1}$. These injections have been compared with previous work performed at 6.0 feet per day. Gelation is shown to be inhibited by increased flow rate and is considered to be due to extra energy in the flow field and the reduced pore transit time. At 6.0 feet per day few polymer/cross links can form during the pore transit time and, furthermore, passage through the pore throats may disrupt molecular linkages already formed. However, at 1.5 feet per day, the longer pore transit time allows more cross-links to form, and the flow contains insufficient energy to force the aggregating molecules through the pore throats. This was shown for the variable rate injection which exhibited a varying gelation rate. A tentative rate equation has been proposed which relates the gelation rate to the inverse square of the flow rate. A full understanding of any flow rate variation in the gelation rate is crucial to the design of reservoir gel emplacements. (author).

42349 (CMI-R–90/A30001) **An introduction to models and methods for optimization of petroleum production.** Haugland, D. Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway). Feb 1990. 92p. (In Norwegian). Order Number DE90512584. Source: NTIS (US Sales Only), PC A05/MF A01.

This is a survey of various decision problems from the petroleum industry, where mathematical models and methods may be applied with advantage. The problems originate from the different phases of an oil field exploitation: exploration, development, production, operation and transport. All the models studied in the report have been formulated as optimization problems. The methods of solution depend on the structure of the object function, constraints and decision variables. Examples of methods are linear, integer and

dynamic programming. It has been tried to see the formulation of the models in relation to the required computer work, as well as the available optimization methods. 57 refs., 15 figs., 5 tabs.

42350 **SPE/DOE seventh symposium on enhanced oil recovery: Proceedings: EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives.** 924p. Society of Petroleum Engineers, Richardson, TX (1990). Sponsored by U.S. DOE Fossil Energy. From 7. SPE/DOE symposium on enhanced oil recovery; Tulsa, OK (USA); 22-25 Apr 1990.

This report describes eighty-seven research programs on enhanced oil recovery which were presented at the seventh SPE/DOE symposium. Individual projects are processed separately for the data bases. (CBS)

42351 (DOE/CE/15446–T3) **Heavy oil recovery process: Conceptual engineering of a downhole methanator and preliminary estimate of facilities cost for application to North Slope Alaska: Third quarterly report.** S-Cal Research Corp., San Rafael, CA (USA). [1990]. 46p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE15446. Order Number DE90014475. Source: NTIS, PC A03/MF A01 - OSTI.

This report describes the activities during this reporting period in the conceptual engineering of a downhole methanator for application to the Alaskan North Slope for heavy oil recovery. (FI)

42352 (DOE/EIA–0185(89)) **Costs and indices for domestic oil and gas field equipment and production operations, 1987, 1988, 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 16 Jul 1990. 102p. Sponsored by U.S. DOE Management & Administration. Order Number DE90014685. Source: NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

This report presents estimated costs and indices for domestic oil and gas field equipment and production operations for 1987, 1988, and 1989. The costs of all equipment and services were those in effect during June of each year. The sums (aggregates) of the costs for the hypothetical leases by area, depth, and production rate were averaged and indexed. This provides a general measure of the increased or decreased costs from year to year for lease equipment and operations. These general measures may not capture changes in industry-wide costs exactly because of annual variations in the mix of wells. The text of the report contains summary tables, and the appendices contain detailed tables. 22 tabs.

42353 (DTH-ISVA-PR–69) **Progress report no. 69.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. Aug 1989. 84p. Order Number DE90512540. Source: NTIS (US Sales Only), PC A05/MF A01.

A progress report from the Institute of Hydrocynamics and Hydraulic Engineering at the Technical University of Denmark. The publication comprizes eight papers on basic research in the field of hydrodynamics and hydraulic enginering, some of which have relation to offshore platforms and the transport of pollutants in ground water. (AB).

42354 (DTH-ISVA-PR–69, pp. 21-30) **Scour around a vertical pile in waves.** Sumer, B.M.; Fredsoee, J.; Roll, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. 1989. In *Progress report no. 69.* Order Number DE90512540. Source: NTIS (US Sales Only), PC A05/MF A01.

The paper presents the results of an experimental investigation on scour around a vertical pile exposed to waves. The results indicate that the vortex shedding is the key element in the scour process. The horse-shoe vortex is insignificant in the process, as opposed to what occurs in steady currents. It is demonstrated that the Keulegan-Carpenter number KC is the main parameter governing the equilibrium scour depth. (author).

42355 (DTH-ISVA-PR–69, pp. 79-87) **Visualization of the flow around cylinders at small KC numbers.** Jensen, B.L.; Roll, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. 1989. In *Progress report no. 69.* Order Number DE90512540. Source: NTIS (US Sales Only), PC A05/MF A01.

The flow pattern around cylinders in planar oscillatory flow at KC numbers below 7 is visualized by the aluminium powder technique, ant the pattern is qualitatively related to the forces acting on the cylinders. The increase in the vortex strength and the increased asymmetry of the flow patterns found, as the KC number is increased, are discussed. (author).

42356 (IKU-R–34.2821.00/01/89) **Properties of flowing foam in porous materials with non-mobile oil present.** Holt, T.; Kristiansen, T.S. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Nov 1989. 28p. (In Norwegian). Order Number DE90512581. Source: NTIS (US Sales Only), PC A03/MF A01.

The properties of flowing foam in porous materials, expressed as apparent viscosity, have been investigated with various types of oil present, with variable tensid concentration and for different porous materials. The effect of aging of core material with tensid solution has been examined. In addition, loss of tensid by foam flooding because of adsorption on the surface of the core material, has been measured. The results show that type of oil may have great influence on the properties of the foam. The dispersion properties of the oil are probably an important factor, but other conditions may also have an effect. A flowing foam's apparent viscosity depends on the concentration of the solution of the tensid. A considerable increase of the viscosity was observed when the concentration of the tensid increased from 0.25 to 1.0 weight percentage. The flow properties were relatively unaffected by an increase in the permeability of the porous material from 0.5 to 2.6 darcy. Aging of the core material with tensid solution before foam flooding caused increased flow resistance. Loss of tensid because of adsorption was relatively unaffected by the test conditions, and was very similar to maximum adsorption loss measured for ordinary tensid solutions. 9 refs., 10 figs., 12 tabs.

42357 (STF–75A89039) **Dropped objects on subsea installations.** Subsea equipment reliability and availability. Sundet, I. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Sep 1989. 90p. Order Number DE90512579. Source: NTIS (US Sales Only), PC A05/MF A01.

Probabilities of dropping objects from platforms have been assessed, based on available data sources. The probability of major accidents caused by dropped objects has been assessed for a specific example. 30 refs., 20 figs., 16 tabs.

42358 **Surfactant-based mobility control: Progress in miscible-flood enhanced oil recovery.** ACS symposium series 373. Smith, D.H. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 449p. American Chemical Society, Washington, DC (USA) (1988). (CONF-8706398–: Surfactant-based mobility control: progress in miscible-flood enhanced oil recovery, Ann Arbor, MI (USA), 21-24 Jun 1987).

This volume summarizes the current status of surfactant-based mobility control and research that has been performed on this emergent technology. Topics covered include: Stability of miscible displacements and Foam stability: effects of oil and film stratification.

42359 **Directional drilling experience with air.** Carden, R.S. (GSM and Associates, Amarillo, TX (US)); Yost, A.B. II. pp. 85-88 of Proceedings of the drilling technology symposium 1990: Volume 27. Weiner, P.D.; Kastor, R.L. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

Air is not a common circulating medium when using directional drilling techniques in rotary drilled bore holes. There are problems associated with air that can cause additional expenses. These problems are downhole motor life, hole cleaning at inclinations above 50°, and surveying methods. The authors report how, in drilling several high inclination and horizontal wells, most of the problems have been solved. Because of the advantages of air drilling, directional drilling with air can be cost competitive with directional wells drill with drilling mud.

42360 **A new approach of directional survey interpretation and course correction by the sectional method.** Long, R.C.

(U.S. Dept. of Energy, Yucca Mountain Project Office, Las Vegas, NV (US)); Mitchell, B.J. pp. 71-84 of Proceedings of the drilling technology symposium 1990: Volume 27. Weiner, P.D.; Kastor, R.L. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

An oblique circular arc representation for wellbore trajectories, a geometric analysis termed the sectional method, is presented. This approach permits projected line segments to be functions of the dogleg angle and to be related usually measured displacements between survey stations. The advantages of this analysis are: a solution for the dogleg angle and a method of survey interpretation, the sectional method; a procedure for exact interpolation of true vertical depth, azimuth, and inclination between survey stations; a basis of solution for a computer program which provides course correction information during a turn to a target. The program provides a solution summary for a course correction from various survey stations in a well to any planned target.

42361 Coring the horizontal hole. Eaton, N. (Eastman Christensen, Houston, TX (US)). pp. 65-70 of Proceedings of the drilling technology symposium 1990: Volume 27. Weiner, P.D.; Kastor, R.L. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

A recovery efficiency test (RET) on a well in Wayne County, West Virginia, completed in late 1986, was the first horizontal well in the world to be motor-drilled on air and, with successful recovery of 73 feet (22.5 m) of core, also became the first horizontal well to be cored on air. The well reached 90 deg of inclination at 4020 ft (1225 m) MD when coring began in the 7-7/8 inch hole using a lateral coring system which provides the focus of this paper. In addition to the RET No. 1 well, additional case histories describe the lateral coring equipment and procedures employed in the successful recovery of formation samples from medium- and short-radius horizontal wells. Summarizing the current technology, the discussion concludes an overview of new developments in horizontal coring.

42362 Organized surfactant assemblies in supercritical fluids. Fulton, J.L. (Pacific Northwest Lab., Battelle Boulevard, Richland, WA (US)); Smith, R.D. pp. 91-107 of Surfactant-based mobility control: Progress in miscible-flood enhanced oil recovery. Smith, D.H. American Chemical Society, Washington, DC (USA) (1988). (CONF-8706398–: Surfactant-based mobility control: progress in miscible-flood enhanced oil recovery, Ann Arbor, MI (USA), 21-24 Jun 1987).

Reverse micelle and microemulsion solutions are mixtures of a surfactant, a nonpolar fluid and a polar solvent (typically water) which contain organized surfactant assemblies. The properties of a micelle phase in supercritical propane and ethane have been characterized by conductivity, density, and solubility measurements. The phase behavior of surfactant-supercritical fluid solutions is shown to be dependent on pressure, in contrast to liquid systems where pressure has little or no effect. Potential applications of this new class of solvents are discussed.

42363 Promise and problems of miscible-flood enhanced oil recovery. Smith, D.H. (Enhanced Oil Recovery Group, Morgantown Energy Technology Center, U.S. Dept. of Energy, Morgantown, WV (US)). pp. 2-37 of Surfactant-based mobility control: Progress in miscible-flood enhanced oil recovery. Smith, D.H. American Chemical Society, Washington, DC (USA) (1988). (CONF-8706398–: Surfactant-based mobility control: progress in miscible-flood enhanced oil recovery, Ann Arbor, MI (USA), 21-24 Jun 1987).

There is no known method or collection of methods that can recover all of the petroleum from an underground reservoir. Even when several different methods are applied sequentially over a period of decades, on average, they leave about two-third of the oil trapped in the reservoir. This paper presents an assessment of miscible-flood enhanced oil recovery.

42364 Injectivity and surfactant-based mobility control. Smith, D.H. (Enhanced Oil Recovery Group, Morgantown Energy Technology Center, U.S. Dept. of Energy, Morgantown, WV (US)). pp. 429-438 of Surfactant-based mobility control: Progress in miscible-flood enhanced oil recovery. Smith, D.H. American Chemical Society, Washington, DC (USA) (1988). (CONF-8706398–: Surfactant-based mobility control: progress in miscible-flood enhanced oil recovery, Ann Arbor, MI (USA), 21-24 Jun 1987).

Several field tests of injectivity and of various types of surfactant-based mobility control for gas flooding have been reported in the literature. These are reviewed for clues to possible future directions for the technology and as a guide to the research and development needed for achieving technical success and commercialization of surfactant-based mobility control for gas flooding.

42365 Developing expert systems. Ferrada, J.J. (Oak Ridge National Lab., TN (USA)); Holmes, J.M. *Chemical Engineering Progress (USA)*, 86(4): 34-41 (Apr 1990).

Artificial intelligence (AI) is a growing field that is making slow but stead progress in the chemical engineering area. Chemical engineers are involved in developing expert systems using artificial intelligence of a wide variety of systems. This article establishes a sequential procedure for the development of certain expert systems. First, it analyzes some basic concepts of AI. Second, it describes a methodology for the development of an expert system. Third, it gives an example of the development of a particular expert system. And fourth, it discloses where one can obtain training in developing expert systems.

42366 Rock bit with rigid face seals and recessed energizers. Kelly, J.L. Jr.; Welsh, M.F. To Hughes Tool Co., Houston, TX (USA). USA Patent 4923020/A/. 8 May 1990. Filed date 23 Jun 1988. USA Patent Application 7-210,681. Int. Cl. E21B 10/20. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an earth boring bit with an improved pressure compensating face seal means. It comprises: a body; a cantilevered bearing shaft extending obliquely inwardly and downwardly from the body; a cutter secured for rotation about the bearing shaft, with axial and radial play due to clearances; a lubrication system in the body, including a hydrostatic pressure compensator; seal groove means including registering shaft and cutter seal grooves with a pair of oppositely facing radial end walls and a pair of oppositely facing circumferential, beveled walls, one located in the cutter and the other in the shaft, each of which intersects a respective radial end wall.

0206 Health and Safety

Refer also to citation(s) 42357

42367 (STF–75A89028) **A scenario-method for evaluating offshore control centers.** Risk analysis and safety management. Ingstad, O.; Bodsberg, L. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Aug 1989. 100p. Order Number DE90512585. Source: NTIS (US Sales Only), PC A05/MF A01.

The report presents a scenario-method for evaluating the ability of the offshore control center to handle abnormal situations. The analysis team using the method is able to identify deficiencies in a proposed control room concept, which may be used as a basis for recommendations. The analysis is carried out through discussion sessions with process, safety, instrument and operations personnel. The method initially provides a checklist for a general analysis of layout, environment, control and safety systems, job organization, procedures and training. In the scenario analysis, the control room operators' responses to potential accident scenarios are simulated. The method provides guidelines for designing scenarios and describing operator tasks. Deficiencies in handling the scenarios are identified through checklists covering operator detection, diagnosis and action. A procedure for identifying the most important deficiencies is also presented. 28 refs., 16 figs.

42368 (STF–75A89029) **Safe operation of offshore production installations: Research program final report.** Risk analysis and safety management. Bodsberg, L.; Hokstad, P.; Ingstad, O. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim

(Norway). Sep 1989. 50p. Order Number DE90512586. Source: NTIS (US Sales Only), PC A03/MF A01.

The report summarizes main findings from the research program Safe Operation of offshore Production Installations. The program objectives have been to: Identify problem areas and give criteria for solution concerning the offshore control center's handling of crisis situations on offshore production installations; Identify safety system configurations which ensure high production regularity and at the same time comply with safety regulations, and to develop analytical models and methods for reliability prediction of computer-based systems. 9 refs., 8 figs., 3 tabs.

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42347, 42351, 42352

42369 (DOE/EIA–0109(90/05)) **Petroleum supply monthly, May 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 25 Jul 1990. 127p. Sponsored by U.S. DOE Management & Administration. Order Number DE90015077. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

Data presented in this report describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 states and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply." Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States.

0209 Environmental Aspects

42370 (IKU-R–22.1938.00/01/89) **Review of research studies on oil spill dispersants performed in Scandinavia.** Daling, P.S.; Halmoe, G. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Oct 1989. 70p. Order Number DE90512589. Source: NTIS (US Sales Only), PC A04/MF A01.

This project gives a review of the research on oil spill dispersants which has been performed in the Scandinavian countries during the past 10 years. Approximately 60 titles have been selected and reported. The report covers the following items: The present attitude to dispersants and national regulations for use of dispersants in the Scandinavian countries; Research programs on oil spill dispersants carried out, or presently running; Review of project studies (reports/publications); Recommendations for further work.

42371 (IVL-B–955) **Distribution and effects of oil in Swedish coastal waters and commentaries concerning the potential damage of a release from a simulated blowout from a borehole east of Gotland.** Linden, O. Swedish Environmental Research Inst., Stockholm (Sweden). May 1990. 10p. (In Swedish). Order Number DE90512639. Source: NTIS (US Sales Only), PC A02/MF A01.

Major oil spills from blow-outs may have drastic and long-lasting consequences in the Baltic ecosystem. Large number of seabirds and a large percentage of the remaining seal population are likely to be affected. The impact in littoral as well as sublittoral ecosystems are likely to remain for 10 years or more. The results of the investigation indicate that Environmental Impact Assessments must be carried out before any drilling is started.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 42345

0303 Drilling, Production, and Processing

Refer also to citation(s) 42352, 42359, 42360, 42361, 42365, 42366

0304 Products and By-Products

42372 An evaluation of direct methane conversion processes. Fox, J.M. III (Bechtel National, Inc., San Francisco, CA (USA)); Chen, T.P.; Degen, B.D. *Chemical Engineering Progress (USA)*, 86(4): 42-50 (Apr 1990).

Methane is the primary constituent of both natural gas and the associated gas resulting from crude oil production. These gases have little value unless they can be moved to large-scale consumers through a pipeline or transported as liquefied gases. Because conversion of methane to a transportable liquid hydrocarbon fuel would open new markets, it is a goal being actively pursued by many groups around the world. Currently, two large-scale, viable approaches for converting methane to liquid hydrocarbons are being used: the methanol-to-gasoline (MTG) route, and the Fischer–Tropsch (FT) route. Both of these processes begin with the production of synthesis gas from methane,which is a high-temperature, endothermic, costly operation. Concepts for directly converting methane to a liquid hydrocarbon fuel without reforming methane to synthesis gas conceptually appear attractive. A few have reached the stage where a preliminary evaluation directed at understanding the critical process factor is possible. The authors report on their studies involving the following process schemes: oxidative coupling, partial oxidation, and oxyhydrochlorination.

0305 Health and Safety

Refer also to citation(s) 42367, 42368

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42352, 42919

42373 (DOE/EIA–0130(90/05)) **Natural gas monthly, May 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 30 Jul 1990. 145p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90014506. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

This report highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and undergrounds storage data are also reported. 7 figs., 33 tabs.

0320 Transport, Handling, and Storage

42374 (DTH-NI–88-09) **Optimization of large networks for natural gas.** Thorp Hansen, C. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Numerisk Inst. Dec 1988. 149p. Source: Available on loan from Danmarks Tekniske Bibliotek, Anker Engelundsvej 1, DK-2800 Lyngby.

The thesis treats an algorithm for optimal dimensioning of a network for distributing natural gas in a town. The layout of the newtork is given, but the diameters of the pipes can be varied. In practice there are typically 5-10 standard diameters to choose between. The aim is to determine that set of pipe diameters the utilization of which will minimize the costs of the networks realization in relation to supply of a given quantity of gas. In the algorithm presented the minimization is performed using successive linear programming in an optimization method of the"trust region" type. The variables are the pipe diameters, i.e. discrete. Determination of the gas flow and pressure in the newtork for a given set of pipe diameters is formulated as the solving of a nonlinear equation systems. When performing steady-state analysis, gradients are known and therefore Powell's dog-leg system has been revised in order to utilize this information. Thus the efficiency and stability of the method has been increased. As the algorithm should be used for the optimization of large networks with more than 100 pipes and

nodes, sparse matrix techniques are used to exploit the structures involved. An example of a natural gas network in a Danish town is described and the user's guide to FORTRAN 77, a computer programme implemented for the performance of the algorithm, is presented. (AB) 22 refs.

42375 (SV-UG–1988-35) **Rules and guidelines for submarine pipeline for natural gas.** Stroemsjoe, A. Swedish State Power Board, Vaellingby (Sweden). 27 Sep 1988. 30p. (In Swedish). Order Number DE90512598. Source: NTIS (US Sales Only), PC A03/MF A01.

This report is a preliminary comparison between the 2 most common international guides today used for submarine pipelines for natural gas on long distances. A comparison has been made between two alternatives: * DET NORSKE VERITAS. Rules for submarine pipeline systems. * ASME Guide For GAS Transmission and Distribution Piping Systems and there refered other ASME guides. Alternative 1 is a relatively new guide written especially for submarine pipelines. The guide is for this reason more simple to overlook and use. This guide has also probably been used for most of the installations in the North Sea area. Alternative 2 contains many references to other American guides, is more difficult to overlook and use. The demands on submarine pipeline are relatively bad specified. As a result of this study it is recommended to use alternative 1 for future Swedish submarine pipelines.

42376 (SV-UG–1989-12) **Water-sealed natural gases: Permitted gas pressure with regard to shear fracture in the rockmass.** Lindblom, U. (GECON AB/CTH Goeteborg (SE)); Soeder, C.O. Swedish State Power Board, Aelvkarleby (Sweden). 8 Dec 1989. 45p. (In Swedish). Order Number DE90512620. Source: NTIS (US Sales Only), PC A03/MF A01.

To optimize pressure and location in depth in un-lined gas storage spaces exact hydromechanical calculation methods are needed. The method presented in the report is based on a theory for shear propagation in crystalline rock masses as a result of high injected water pressures. The accuracy of the theory has been verified by large-scale experiments in granite. In principle the strain condition corresponds to that prevailing in rock round a water curtain, where the water pressure is allowed to gradually rise. The limit pressure of the water curtains is defined by the shearing beginning to occur in critically oriented rock fissures. The limit pressure on its part determines the highest allowable gas pressure and by that the storage capacity of the rock plant. The method presented thus provides a powerful instrument for optimization of location in depth of un-lined gas storage spaces. The limit pressure of a gas storage depends on the following parameters of rock mechanical nature: * the rock strains, defined by the three main stresses and their increase from the ground level and downwards, * the joint sets and their orientation in relation to the rock strains, * the friction angle in the joint sets. The parameters mentioned could at a planned location of a gas storage be determined by preinvestigation drillings supplemented by strain measurements and laboratory tests. What gas pressures are then possible to attain in water sealed storage rooms in Swedish bed-rock? One can get a general idea by utilizing average rock strain data from a recently made Scandinvian inventory (FRSDB: Fennoscandian Rock Stress Data Base). If one furtheron conservatively assumes that there always are joint sets in the rock that are oriented in the most unfavourable way in relation to the rock strains and that these joint sets have a friction angle of 35 degrees, then the possible gas pressure may be described. (9 figs., 19 tabs., 19 refs.).

0340 Combustion

Refer also to citation(s) 43262

42377 (LUTMDN-TMVK–5188-1-74-1990) **Pulse combustion: A study of the influence of the gas supply for a given pulse combustor.** Lindholm, A. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Mar 1990. 75p. (In Swedish). Order Number DE90512596. Source: NTIS (US Sales Only), PC A04/MF A01.

Examination paper.

The purpose of this work has been to examine changes in operating characteristics for a given pulsating combustor at changed gas supply. The change in gas supply has been achieved by variations in gas pressure and valve stroke. Increased gas pressure results in an enhancement in burner input, until a gas pressure is reached where an enhancement in pressure doesn't give an enhancement in burner input. The combustion chamber average pressure (RMS) and the frequency increases with burner input, but at maximum burner input the average pressure is slightly decreased. However, the frequency continues to increase. The burner input depends upon gas pressure, combustion chamber pressure and frequency. Within the combustor's best operating range the combustion is good with a satisfactory low amount of carbon monoxide in the flue gases. The influence of valve stroke is most notable at high burner input, but the changes are on the whole very small. An increased amount of carbon monoxide and excess air can be noticed with increased valve stroke at high burner input. The results of this report coincides well with measurements that has been made in other, foreign reports. A studie of heat transfer in a chosen part of the resonance tube shows that the overall heat transfer coefficient is at least 2.5 times better at pulasting flow than at calculated stationary flow.

42378 (SV-UG–1990-14) **Boiler combinations.** Jaermyr, A.K. Swedish State Power Board, Vaellingby (Sweden). 21 Dec 1989. 72p. (In Swedish). Order Number DE90512599. Source: NTIS (US Sales Only), PC A04/MF A01.

The object of this report is to enlighten certain questions about how to design and select alternative system in projecting a natural gas fired central boiler plant, meant for heat and hot water supply. A number of system solutions is presented with the purpose to give recommendations for the most suitable system for a certain power requirement. Central boiler plants with one boiler or two boilers have been designed for the two following representative power rates: * 1 MW with the annual energy demand of 2200 MWh. * 5 MW with the annual energy demand of 11000 MWh. Besides these differences between series and parallel connection on the water side for central boiler plants with two boilers has been assessed for the power rate 1 MW. In total five different system solutions have been studied. For the power requirement 1 MW, select a central boiler plant with one boiler, since the price for boiler and burner is almost half of the equivalent price for a plant with two boilers. The annual efficiency, on the other hand, is nearly the same for the two systems. For the power requirement 5 MW, select a central boiler plant with two boilers. The investment cost for boiler and burners is also in this case more expensive for two boilers than for one (but the difference is not as big as in the case of the 1 MW system). The increase of annual efficiency however can make the investment profitable. The selection between parallel and series connection is arbitrary. The investment is a little lower with series connection since only one of the boilers needs a modulated burner. With parallel connection a higher annual efficiency is obtained and therefore brings down the energy costs. These results can of course not be applied for all central boiler plants since many other aspects than cost are important in selecting systems. The availability of the plant is probably the most important aspect, and the space limits can also be determining.

04 OIL SHALES AND TAR SANDS

0403 Drilling, Fracturing, and Mining

42379 **Proceedings of the second international symposium on rock fragmentation by blasting.** Fourney, W.L. (Maryland Univ., College Park, MD (USA)); Dick, R.D. 676p. Society for Experimental Mechanics, Bethel, CT (USA) (1987). (CONF-870867–: 2. international symposium on rock fragmentation by blasting, Keystone, CO (USA), 23-26 Aug 1987).

This is the second international meeting of researchers in rock fragmentation by blasting. The symposium continues the information exchange initiated at the previous conference and to determine relevant directions for future research on fracture and fragmentation of rock.

42380 **A new constitutive model for fragmentation of rock under dynamic loading.** Kuszmaul, J.S. (Sandia National Labs.,

Albuquerque, NM (USA)). pp. 412-423 of Proceedings of the second international symposium on rock fragmentation by blasting. Fourney, W.L.; Dick, R.D. Society for Experimental Mechanics, Bethel, CT (USA) (1987). DOE Contract AC04-76DP00789. (CONF-870867–: 2. international symposium on rock fragmentation by blasting, Keystone, CO (USA), 23-26 Aug 1987).

A constitutive model for rock subjected to blast induced fracturing is introduced. When the rock experiences tensile loading, microcracking occurs, which degrades the material stiffness. The model includes an effect that occurs at high densities of microcracks. The zones of stress relieved material around microcracks can overlap. In compression, the rock response is elastic, perfectly plastic. The constitutive model is compared to an earlier model using a simple problem involving loading to failure of a sample of rock under constant strain rate. The new model predicts that failure to be sudden or brittle, as is expected for rocks. The model is also applied to a single-blastwell cratering test in oil shale. It is used to calculate the extent of fragmentation and the particle sizes of the rubble.

42381 **Computational and experimental studies of the role of stemming in cratering.** Hommert, P.J. (Sandia National Labs., Albuquerque, NM (USA)); Kuszmaul, J.S.; Parrish, R.L. pp. 550-562 of Proceedings of the second international symposium on rock fragmentation by blasting. Fourney, W.L.; Dick, R.D. Society for Experimental Mechanics, Bethel, CT (USA) (1987). DOE Contract AC04-76DP00789. (CONF-870867–: 2. international symposium on rock fragmentation by blasting, Keystone, CO (USA), 23-26 Aug 1987).

A set from a series of cratering experiments in oil shale is used as the basis for studying the effect of stemming on blasting. The experimental data indicated that the stemmed and unstemmed tests were essentially identical. A dynamic solid response code is used in conjunction with a constitutive model for rock failure to calculate the blastwell pressure histories. Calculations indicate that the early time expansion of the blastwell from the initial detonation pressure is the same with or without stemming. While the presence of stemming significantly increases the potential momentum available to the rock, this momentum is not effectively transferred into greater rock dislocation in a cratering geometry.

0404 Oil Production, Recovery, and Refining

42382 (DOE/LC/11060–2846) **Oil shale retorting using electromagnetic methods: Final report.** Inguva, R.; Baker-Jarvis, J. Wyoming Univ., Laramie, WY (USA). Dept. of Physics and Astronomy. Sep 1988. 324p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85LC11060. Order Number DE90009656. Source: NTIS, PC A15/MF A01 - OSTI; GPO Dep.

The enclosed report presents the results of a three year study on the retorting of oil shales by electromagnetic methods. The main aim of this study was twofold: (1) to obtain reliable data on the various retorting parameters such as dielectric constants, temperature profiles, permeabilities, oil yields, etc., for the case of bench scale retorting of a shale block by electromagnetic methods using a monopole antenna; and (2) to develop and validate a mathematical model using this data. Reliable data have been obtained using a bench scale retort to heat shale blocks using monopole antennas under various conditions. Data have been obtained for dielectric constants and permeabilities. A mathematical model has been developed to interpret the present data. Combined with all the earlier experimental work in the literature, economics of the heating process has been studied following the earlier work by Bridges and his group, and Mellon. Feasibility studies of other configurations such as phased arrays have been conducted. 61 figs., 5 tabs.

0405 Properties and Composition

Refer also to citation(s) 42382

0408 Economic, Industrial, and Business Aspects

42383 (DOE/MC/11076–2830) **Process engineering study for a 2000 barrels-per-day shale oil production facility.** Walker, G. (Ford, Bacon and Davis, Inc., Salt Lake City, UT (USA). Utah Div.); Betenson, G.; Walker, L. Western Research Inst., Laramie, WY (USA); Ford, Bacon and Davis, Inc., Salt Lake City, UT (USA). Utah Div. Aug 1989. 35p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC21-86MC11076. Order Number DE90000496. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The capital and operating cost for a 2000 bbl/day shale-oil-processing plant utilizing a Paraho process combined with an inclined-fluid-bed retort to process the shale fines are $82,097,600 and $11,091,000/yr, respectively. If the inclined-fluid-bed retort is replaced with a power-generation system, the capital cost changes to $96,240,000 and the operating cost changes to $9,233,000/yr. The above costs do not include any allowance for Paraho licensing and royalties, mining of the oil shale or viscosity enhancement of the asphalt-blend product. The cost information is in mid-1989 dollars and represents an accuracy of plus or minus 30 per cent. The decrease in operating cost of power-generation case does not merit the corresponding increase in the capital investment. The inclined-fluid-bed retort therefore appears to be the most economical method for processing the raw-shale fines. 11 refs., 7 figs., 7 tabs.

0409 Waste Management

Refer also to citation(s) 42383

42384 (DOE/LC/11049–2847) **Oil shale process water evaporation: Final report.** Hasfurther, V.R.; Reeves, T. Wyoming Univ., Laramie, WY (USA). Dept. of Civil Engineering. Jan 1990. 158p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84LC11049. Order Number DE90009659. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The primary objectives of this research program were to study chemical, microclimatological, and interactive effects on the evaporation of low-quality oil shale process wastewaters to develop more applicable evaporation models and evaporation design criteria for the disposal of oil shale process waters and to analyze the processes associated with the release of potentially toxic emissions from these low-quality effluents. The research program incorporated field and laboratory studies analyzing microclimatic and chemical effects on the evaporation of oil shale process wastewaters. Field studies at Laramie, Wyoming were designed to continuously monitor microclimatological conditions and the evaporation from three low-quality effluents using Class A evaporation pans. Fresh water evaporation was monitored as a control. Process waters were routinely monitored for concentrations of organic and inorganic constituents. Laboratory studies were designed to isolate and describe significant climatic, chemical, and interactive effects on evaporation rates. Results from the above studies were utilized to develop a regression model to predict evaporation from these low quality effluents. This model was then compared to commonly utilized models to estimate evaporation. A stochastic model was developed using a first order markov process to generate 1000 20-year climatological records. Mass balance techniques were then used to evaluate the new data sets for evaporation processes and determine critical design parameters for evaporation disposal ponds. Laboratory studies were conducted to determine significant effects on the Henry's Law Constant for eight organic compounds in two process waters. 69 refs., 16 figs., 51 tabs.

0430 Transport, Handling, and Storage

Refer also to citation(s) 42383

05 NUCLEAR FUELS

Refer also to citation(s) 43108

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 43284

0504 Feed Processing

Refer also to citation(s) 42592

42385 (CDTN-DETM-DIPRS–002/81) **Studies of chemical and physical process for processing Itataia ore, C E, Brazil.** Coelho, S.V.; Fernandes, M.D. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 15 Jun 1981. 32p. (In Portuguese). Order Number DE90635174. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A basic description of technical activities involved in chemical and physical processes studies to Itataia ore processing, in Brazil is prese nted. (C.M.).

42386 (CDTN-DETM-DIPRS–016/83) **Alternative process for uranium recovery of Itataia phosphoric acid.** Duarte Neto, J.; Arruda, F.R.B.; Silva, G.L. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). May 1983. 89p. (In Portuguese). Order Number DE90635175. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The uranium recuperation in Itataia phosphoric acid by liquid-liquid extraction, using the D2EHPA-TOPO like extracting is described. (C.M.).

42387 (CDTN-DETM-PD–015/84) **Continuous tests of Phosphoric Acid - dihydrate process - from phosphatic concentrate of Itataia-CE ore.** Santos Benedetto, J. dos. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1984. 157p. (In Portuguese). Order Number DE90635176. Source: NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

A consolidation of principal studies and continuous tests done with phosphatic concentrated of Itataia ore intending phosphoric acid production by humid-route dihydrate way process is presented. The production of phosphoric acid is applied in uranium extraction process by solvents. (author).

0505 Uranium Enrichment

Refer also to citation(s) 42406, 43117

42388 (CEA-CONF–10042) **Inorganic membranes for separative techniques: from uranium isotope separation to non-nuclear fields.** Charpin, J.; Rigny, P. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1989. 16p. (CONF-8907102–:). Order Number DE90511935. Source: NTIS (US Sales Only), PC A03/MF A01.

Uranium enrichment leads to the development of inorganic porous barriers - either ceramic or metallic. A wide range of these products had considerable potential for the improvement of filtration techniques in liquid media (ultrafiltration and microfiltration). This is how a new generation of inorganic membranes was created reputed for their performance and especially for their lifetime and their behaviour (mechanical and temperature stability, corrosion resistance). These membranes now have a respectable position in applications in the agro-food biotechnology industries, to give only two examples. Before the non-nuclear applications of inorganic membranes are presented, their success in the nuclear power industry are pointed out.

42389 (K/ITP–310) **Uranium enrichment plant characteristics: A training manual for the IAEA [International Atomic Energy Agency].** Whitaker, J.M. Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1990. 84p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. (ISPO–310). Order Number DE90013270. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This manual and the five others in this series are intended to provide the student with an overview of the technology involved in the nuclear facility types most often encountered in safeguards inspections. This particular manual addresses uranium enrichment plants. The other manuals consider fuel fabrication plants, research reactors, critical assembly facilities, nuclear power plants, and reprocessing plants. The primary objective of this training manual is to familiarize an inspector with the basic principles, concepts, structure, and operation of uranium enrichment plants necessary for conducting inspections. Although all existing enrichment methods are discussed, this manual focuses on the gas centrifuge enrichment method because it is the only type of enrichment facility currently under International Atomic Energy Agency (IAEA) safeguards. Review questions, figures, and tables are included in each chapter.

0507 Fuels Production and Properties

Refer also to citation(s) 42394, 42599, 42600, 42684, 42734, 43030, 43040, 43476

0508 Spent Fuels Reprocessing

Refer also to citation(s) 42540, 42599, 42603, 42606, 42665, 42732, 43032

42390 (KFK–4589 IV.1-IV.26) **Operating experience of the WAK with the reprocessing of high burnup LWR and MOX fuel elements.** Willax, H.O.; Weishaupt, M.; Schegk, J. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The reprocessing of the fuel elements from LWR with average burnups of more than 30 GWd/t U was of special significance for the gain in experience of the Karlsruhe reprocessing plant (WAK). The original operating permit with a maximum permissible burnup of 12 GWd/t U and an enrichment before irradiation of up to 1.5% U-235, maximally, was not sufficient for this purpose. Therefore, various applications according to section 7 of the Atomic Energy Act were filed to obtain the permit for the reprocessing of high burnup fuel elements. The elaboration of the marginal conditions for reprocessing in the WAK is shown with the example of the campaigns in connection with the multipurpose research reactor, GKN nuclear power plant and the Stade nuclear power plant. (DG).

42391 (KFK–4589 IX.1-IX.11) **State of fission products in the fuel and fission product behaviour during dissolution of fuel elements including higher burnup MOX fuel elements.** Kleykamp, H. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Wuertz, R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The dissolution tests on irradiated LWR-UO_2 fuel (BE 104/127 KWO, BE 191 Biblis A) indicated that the volume of solid residue increases more than proportional with the burnup. The composition of the residue depends on the fuel temperature during irradiation. The major part of the residue is formed by fission products, which after the dissolution with HNO_3 precipitate as hydroxides. Ru with 60% of the yield is the largest part of the residue. (DG).

42392 (KFK–4589 V.1-V.7) **State and goals of development in the reprocessing of nuclear fuels.** Ebert, K. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Heisse Chemie); Schmieder, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

Studies with the process model VISCO and accompanying investigations with the LABEX and MINKA systems brought about results which lead to the conclusion that, in principle, the required

separative power can be achieved in one single extraction cycle. The concept of the Nuclear Research Centre Karlsruhe for solvent scrubbing with a hydrazine hydrate solution loaded with CO_2 could also be demonstrated successfully. (DG).

42393 (KFK–4589 X.1-X.13) **Higher burnup of fuel elements and its impact on the flowsheet of the PUREX process.** Finsterwalder, L. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft mbH (WAK), Eggenstein-Leopoldshafen (Germany, F.R.)); Stollenwerk, A.H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The process requirements in the separation of fission products and actinides depend primarily on the concentration in the fuel to be reprocessed. With long lived nuclides the concentration in the fuel increases above proportion with the burnup. The most important representative of this group is Np-237. With increasing burnup also the amount of salt in the high-level radioactive waste increases, the neutron poison contents, the Pu-238 contents and the Zr contents increase, the latter causing enhancec formation of crud by the hydrolysis of the zirkonium nitrate. The various stages of oxidation of Np are a problem in the PUREX process. (DG).

42394 (KFK–4589 XI.1-XI.14) **Recycling of fission products obtained by reprocessing. Experience so far and foreseeable problems with plutonium processing.** Krellmann, J. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The 13 tables without comments concern the production of MOX fuel rods, MOX pellets, the plutonium composition in the uranium fuel, the annual accumulation of plutonium from the reprocessing plant, production capacities of the ALKEM and investment plans of the ALKEM. (DG).

42395 (WHC-MR–0162) **Plutonium Uranium Extraction plant (PUREX) annual integrated appraisal, 1988.** Wedlick, H.L. Westinghouse Hanford Co., Richland, WA (USA). Jun 1990. 122p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90013864. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This annual safety appraisal of the Plutonium Uranium Extraction (PUREX) facility fulfills contractor internal audit requirements specified by US Department of Energy (DOE). Fifteen subject areas, and their relevant criteria, were selected for this appraisal. The criteria, findings or observations and the individual appraiser's recommendations make up the body of this report. This is the first annual appraisal performed for PUREX by the Westinghouse Hanford Company. Some new methods and practices were implemented; for example, this is the first time a seriousness category classification system was used to rate the importance of each item.

42396 (WHC-SP–0530) **Chemical processing FY 1990 program and operating plan.** Westinghouse Hanford Co., Richland, WA (USA). 22 Dec 1989. 116p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90014319. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes the Westinghouse Hanford Company (WHC) Chemical Processing Program Plan for fiscal year (FY) 1990. The Plan consists of a program summary, detailed end function program plans and master program schedules. The Program Plan identifies the assumptions and funding requirements to achieve the defined Chemical Processing Program goals. It defines a baseline consisting of detailed scope, schedule and budgets based on the funding guidance for FY 1990. Items that remain unfunded include: Plutonium Finishing Plant (PFP) ductwork remediation, catalyzed electrical plutonium oxide dissolution (CEPOD) development activities, fifth shift training staff, and expense support to outyear non-environmental candidate construction projects. Significant workscope that is only partially funded includes: Plutonium Uranium Extraction (PUREX) Plant final safety analysis report, job control system implementation, material staging upgrades, Pacific Northwest Laboratory continuous air monitor calibration, and PUREX/PFP essential drawing upgrades. In addition, the plan does not take into account funding to support resolution of the listed waste issue at PUREX since the strategy for funding the Liquid Effluent Retention Facility has not been finalized.

0509 Transport, Handling, and Storage

Refer also to citation(s) 42539, 42542, 42544, 42553, 42560, 42575, 42577, 42605, 42705, 42706

42397 (Juel-Conf–65, pp. 107-112) **Transport of nuclear fuel and radioactive waste.** Alter, U. (Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The lecture gives a short survey of the transports of nuclear fuels and radioactive waste in the framework of the fuel cycle within the FRG. It is reported on the responsible authorities, the laws and regulations in force and some practical examples of transport. (orig.).

42398 (ORNL/Sub–89-SD841/2) **Acceptance of canisters of high-level waste by the Federal Waste Management System.** Oak Ridge National Lab., TN (USA); Johnson (E.R.) Associates, Inc., Oakton, VA (USA). Jun 1990. 44p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. (JAI–331). Order Number DE90014786. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report is one of a series of eight prepared by E. R. Johnson Associates, Inc. (JAI) under ORNL's contract with DOE's OCRWM Systems Integration Program and in support of the Annual Capacity Report (ACR) Issue Resolution Process. The report topics relate specifically to the list of high-priority technical waste acceptance issues developed jointly by DOE and a utility-working group. JAI performed various analyses and studies on each topic to serve as starting points for further discussion and analysis leading eventually to finalizing the process by which DOE will accept spent fuel and waste into its waste management system. The eight reports are concerned with the conditions under which spent fuel and high-level waste will be accepted. This document discusses the acceptance of canisters of high-level waste by the Federal Waste Management System. 16 refs., 7 figs., 11 tabs.

42399 (SAND–87-0089) **Spent fuel transportation systems limitations and opportunities.** Stiegler, J.E.; Allen, G.C. Jr.; Cashwell, J.W. Sandia National Labs., Albuquerque, NM (USA). Oct 1988. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (TTC–0714). Order Number DE90014745. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Transportation is a vital link in the commercial radioactive waste management system. The shipment of spent nuclear fuels from commercial power reactors must comply with all applicable transportation regulations, transit through many and varied local areas by several modes, and interface with generators, processor and storage facilities. Moreover, all activities of the transportation system from the design of casks through their ultimate shipment must be performed in a manner that gains public confidence. This paper presents an overview of spent fuel transportation in the United States from a current as well as historical perspective and discusses the planned activities in this area being developed under the sponsorship of the US Department of Energy's Office of Civilian Radioactive Waste Management. The current transportation situation, existing truck and rail size and weight limitations and

current reactor interfaces with the transportation system are discussed, and a summary of the projected shipment estimates for spent fuel is included. The sensitivity of shipment estimates to important transport parameters and possible improvements and opportunities in transportation are presented. 15 refs., 5 figs., 6 tabs.

42400 (UCRL-ID–104572) **Safety implications of burnup effects in criticality safety margins for spent pressurized water reactor fuel transport and storage.** Carlson, R.W.; Fischer, L.E. Lawrence Livermore National Lab., CA (USA). Jul 1990. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014800. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Criticality safety margins must be based upon the combination of the best available prediction of the margin and all uncertainties in the prediction. Inclusion of the effects of burnup in the evaluation of spent fuel shipping or storage casks must be based upon a thorough understanding of the prediction of the effects of burnup and the uncertainties in the measurements (or predictions) of burnup and predictions of the effects. This report presents a preliminary estimate of the effects of burnup and its uncertainties. This will serve as the first step in the effort to develop acceptance criteria that assure public safety. An assembly average burnup of 20,000 MWD/MTU represents an increase in the criticality safety margin of about 20% ($\delta k/k$), and the current estimate of the uncertainty in this value is close to 4% ($\delta k/k$). The uncertainties in the components of the effects of burnup were based upon relevant literature citations and – where no other information was available – upon estimates. Consequently, the margins and uncertainties in the margin presented here should be considered as initial estimates upon which more refined analyses should build to develop a defensible basis for predicting and reviewing the criticality safety margins which include the effects of burnup. 14 refs., 13 figs.

42401 **Spent fuel transportation system limitations and opportunities.** Stiegler, J.E. (Sandia National Labs., Albuquerque, NM (USA)); Allen, G.C. Jr.; Cashwell, J.W. pp. 1-17 of The integrated spent fuel and HLW management system. American Nuclear Society, La Grange Park, IL (USA) (1987). (CONF-870948–: American Nuclear Society topical meeting on the integrated spent fuel and HLW management system, Albuquerque, NM (USA), 28-30 Sep 1987).

This paper presents an overview of spent fuel transportation in the United States from a current as well as historical perspective and discusses the planned activities in this area being developed. The current transportation situation, existing truck and rail size and weight limitations and current reactor interfaces with the transportation system are discussed, and a summary of the projected shipment estimates for spent fuel is included. The sensitivity of shipment estimates to important transport parameters (such as individual cask capacity) and possible improvements and opportunities in transportation are presented.

42402 **Conceptual design of a high-level vitrified waste storage facility.** Machida, N. (Kumagai Gumi Co., Ltd., Tokyo (JP)); Katano, Y.; Kamiya, Y.; Jardine, L.J.; Hoekwater, J. pp. 291-296 of High level radioactive waste and spent fuel management: Volume 2. Slate, S.C.; Kohout, R.; Suzuki, A. American Society of Mechanical Engineers, New York, NY (USA) (1989). (CONF-891006–: Joint international waste management conference, Kyoto (Japan), 23-28 Oct 1989).

This paper discusses a conceptual study of a high-level vitrified waste storage facility to be integrated in the nuclear fuel cycle. The main objective of this study is to ensure high safety, remarkable cost saving and satisfactory technical performance of the facility. The study includes: conceptual design of a storage facility, focusing upon the optimization of the storage process and of the management system, and analytical assessments of technical problems (thermal analysis of the cooling system, safety in case of accident).

42403 **Selected concrete spent fuel storage cask concepts and the DOE/PSN cooperative cask testing program.** Creer, J.M. (Pacific Northwest Lab., Richland, WA (USA)); McKinnon, M.A.; Collantes, C.E. *JNMM (Journal of the Institute of Nuclear Materials Management) (USA)*, 18(3): 10-17 (May 1990).

Water pools, metal casks,horizontal concrete modules, and modular vaults have been used to store the major quantity of commercial light water reactor spent nuclear fuel. This paper reviews the evolution of the development of selected vertical concrete dry storage casks and outlines a cooperative cask testing (heat transfer and shielding) program.

42404 **Description of from-reactor transportation cask designs.** Lake, W.H. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA)). *JNMM (Journal of the Institute of Nuclear Materials Management) (USA)*, 18(3): 34-37 (May 1990).

This paper describes two from-reactor cask development program contracts. They are a contract for legal weight truck cask designs, and a contract for a rail/barge cask design. The paper also presents several general considerations affecting the cask development program. Two of these which are covered in some detail are the technical topics of burnup credit and source term evaluation.

42405 **Experience with failed or damaged spent fuel and its impacts on handling.** Bailey, W.J. (Pacific Northwest Lab., Richland, WA (USA)). *JNMM (Journal of the Institute of Nuclear Materials Management) (USA)*, 18(3): 30-33 (May 1990).

Spent fuel management planning needs to include consideration of failed or damaged spent light-water reactor fuel. This paper describes the importance of fuel integrity and the behavior of failed fuel, the quantity and burnup of failed or damaged fuel in storage, types of defects, difficulties in evaluating data on failed or damaged fuel, experience with wet storage, experience with dry storage, handling of failed or damaged fuel, transporting of fuel, and experience with higher burnup fuel.

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Refer also to citation(s) 42396, 42398, 42400, 42401, 42402, 42403, 42580, 42675, 42705, 42706, 42714, 42780, 42916, 43112, 43293

42406 (CDTN-DETS-PD–003/84) **DIENR.PD experience in decontamination area.** Yadoya, R.T. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 24 Jan 1984. 96p. (In Portuguese). Order Number DE90635342. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

This paper's objective is to give information about the decontamination method of pieces and equipment used by DIENR.PD in uranium isotopic enrichment. (author).

42407 (CONF-900210–Vol.2, pp. 3-10) **Mobile concrete solidification systems for power reactor waste.** Tchemitcheff, E.; Bordas, Y. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In late 1988 SGN received an order from Electricite de France (EDF) for the construction of a mobile concrete solidification system to process secondary system resins generated by the P'4 and N4 series PWR power plants in France. This order was placed in view of SGN's experience with low- and medium-level radioactive waste treatment and conditioning over a period of almost 20 years. In addition to the construction of fixed waste processing facilities using more conventional technologies, SGN has been involved in application of the mobile system concept to the bituminization process in the United States, which led to the construction and commissioning of two transportable systems in collaboration with its American licensee US Ecology. It has also conducted large-scale R & D on LLW/MLW concrete solidification, particularly for ion exchange resins. 5 figs.

42408 (CONF-900210–Vol.2, pp. 11-18) **Shielded railway transporter system equipment design and operational features.** Britts, R.P. (Nuclear Packaging, Inc., Federal Way, WA (USA)); Hedengren, D.C.; Pan, R.B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The U.S. Department of Energy (DOE) Hanford Site at Richland, Washington requires a rail-mounted, shielded transfer system for on-site transfer of radioactively contaminated equipment in the T-Plant, U-Plant, B-Plant and PUREX canyon tunnel facilities. Some typical contaminated equipment are tanks (5-15 tons), reboiler bundles (7 tons), centrifuges (17 tons), moderators (13 tons), and pulse generators (5 tons). The Multipurpose Transfer Box (MTB) is designed and engineered to transport these pieces of equipment and meet specific design constraints for function, operation, and modified 10 CFR 71 normal and hypothetical accident conditions for transport. 8 figs.

42409 (CONF-900210–Vol.2, pp. 23-28) **Low-level radioactive waste involved in transportation events.** Cashwell, C.E. (Sandia National Labs., Albuquerque, NM (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-76DP00789. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Radioactive Materials Incident Report (RMIR) database contains information about radioactive materials transportation accidents and incidents that have occurred in the United States from 1971 through 1989. Using data from RMIR, this paper will provide detailed information on transportation accidents and incidents that have occurred with low-level radioactive wastes. Additionally, overview data on the number of transport accidents and incidents that have occurred and by what transport mode will also be provided. 4 refs., 6 tabs.

42410 (CONF-900210–Vol.2, pp. 29-34) **Transcom's next move: improvements to DOE's transportation satellite tracking systems.** Harmon, L.H. (Dept. of Energy, Germantown, MD (USA)); Harris, A.D. III; Driscoll, K.L.; Ellis, L.G. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In today's society, the use of satellites is becoming the state-of-the-art method of tracking shipments. The United States Department of Energy (US DOE) has advanced technology in this area with its transportation tracking and communications system, TRANSCOM, which has been in operation for over one year. TRANSCOM was developed by DOE to monitor selected, unclassified shipments of radioactive materials across the country. With the latest technology in satellite communications, Long Range Navigation (Loran), and computer networks, TRANSCOM tracks shipments in near-real time, disseminates information on each shipment to authorized users of the system, and offers two-way communications between vehicle operators and TRANSCOM users anywhere in the country. TRANSCOM's successful tracking record, during fiscal year 1989, includes shipments of spent fuel, cesium, uranium hexafluoride, and demonstration shipments for the Waste Isolation Pilot Plant (WIPP). Plans for fiscal year 1990 include tracking additional shipments, implementing system enhancements designed to meet the users' needs, and continuing to research the technology of tracking systems so that TRANSCOM can provide its users with the newest technology available in satellite communications. 3 refs., 1 fig.

42411 (CONF-900210–Vol.2, pp. 35-42) **An overview of the ORNL [Oak Ridge National Lab.] waste handling & packaging plant.** Turner, D.W. (Oak Ridge National Lab., TN (USA)); Berry, J.B.; Moore, J.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC05-84OR21400. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Waste Handling and Packaging Plant (WHPP) is identified as a key element in the U.S. Department of Energy's transuranic (TRU) waste program for both remote handled (RH) and special case (SC) waste. The mission of the facility is to retrieve, receive, repackage, certify, and ship TRU waste to the Waste Isolation Pilot Plant (WIPP) located near Carlsbad, New Mexico. The conceptual design of the WHPP was initiated in March 1989, and the preliminary report was issued in May 1989. The development activities to support the WHPP were initiated during the summer of 1988 and will continue to provide technical information and data to the project over the next several years. An environmental assessment for the WHPP is planned and will be issued in 1991. A summary of each of these areas and the status of the project will be provided in this paper. 3 refs., 5 figs.

42412 (CONF-900210–Vol.2, pp. 43-48) **Automation through the PIP [Program Implementation Plan] concurrence system improves information sharing among DOE [Dept. of Energy] managers.** Imholz, R.M. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)); Berube, D.S.; Peterson, J.L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Program Implementation Plan (PIP) Concurrence System is designed to improve information sharing within the U.S. Department of Energy (DOE) and between DOE and the Field. Effectively sharing information enables DOE managers to make more informed, effective decisions. The PIP Concurrence System improved information sharing among DOE managers by defining the automated process for concurring on a DOE document, thus reducing the time required to concur on the document by 75%. The first step in defining an automated process is to structure the process for concurring on a document. Only those DOE managers with approved access could review certain parts of a document on a concurrence system. Remember that the concurrence process is a sign off procedure

unlike a commentary process in which comments may not be restricted to certain people. The commentary process is the beginning of the concurrence process. The commentary process builds a document; the concurrence process approves it. 6 refs., 7 figs.

42413 (CONF-900210–Vol.2, pp. 49-56) **Leach studies of chelating agents and influence on radionuclide leaching from simulated LLW/ILW cement waste forms.** Vejmelka, P. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Koester, R.; Ferrara, D.; Wacks, M.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Leach studies were performed on cemented waste forms containing sodium nitrate, trace amounts of cesium-137, and cobalt-60, and a chelating agent (ethylene diamine tetraacetic acid (EDTA), nitrilotriacetic acid (NTA), or citric acid). Leaching of the chelates was measured in water and the effect of the chelates on the release of the Cs-137 and Co-60 was studied. The time dependence of the release rate of the chelates is comparable but the chelate concentration in solution and the released fractions are different. EDTA shows the highest release rate followed by NTA and citrate. The release of the non complex forming cesium is not affected by the presence of the chelates. Independent from the strong complex formation of cobalt with EDTA, NTA, and citrate in the alkaline region the cobalt release is also not affected by the presence of the chelates. The high calcium content of the system decreases the stability of the Co complexes in the high pH region (12-13). Experiments were performed to determine the equilibrium concentration of the chelates between liquid and solid phases. The liquid phases were deionized water, saturated sodium chloride, 24 percent magnesium chloride and Q-brine. The equilibrium studies are based on the assumption that in time a stable final condition is to be established in the near field of the waste form in which each compound is at chemical equilibrium between the dissolved and the various solid phases. The total release may be assessed from the concentration in solution and flow rate out of the near field. The fraction of EDTA released from the cement ranged from 0.2 in the Q-brine to 0.5 in the saturated sodium chloride. The concentration of EDSA in solution was dependent on the original amount in the cement sample, but the released fraction was independent of the initial loading. Indicating, EDTA concentration is not affected by solubility limits. 11 refs., 3 figs., 2 tabs.

42414 (CONF-900210–Vol.2, pp. 69-74) **Heat removal options and temperature predictions for a vault of grouted waste.** Crea, B.A. (Westinghouse Hanford Co., Richland, WA (USA)); McCall, T.B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The U.S. Department of Energy's Grout Disposal Program immobilizes low-level radioactive wastes that are stored in double-shell tanks on the Hanford Site. The wastes are mixed with cementitious materials to form a grout. The resulting slurry is then pumped into large underground vaults. Westinghouse Hanford Company developed a method to predict the transient temperature response of these vaults to the heat of hydration of the grout. This method was also used to investigate several options for removing some of the energy generated by the hydration reaction. The results of those analyses are presented here. 3 refs., 7 figs.

42415 (CONF-900210–Vol.2, pp. 75-84) **Groundwater monitoring at the waste isolation pilot plant.** Kehrman, R. (Westinghouse Electric Corp., Carlsbad, NM (USA)); Broberg, K.; Tatro, G.; Richardson, R.; Dasczcyszak, W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-86AL31950. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper discusses the Groundwater Monitoring Program (GMP) being conducted at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. The Regulatory and Environmental Programs (REP) section of the Environment, Safety and Health department (ES&H) is responsible for conducting environmental monitoring at the WIPP. Groundwater monitoring is one of the ongoing environmental activities currently taking place. The REP section includes water-quality sampling and water-level monitoring. The WIPP Project is a research and development facility designed to demonstrate the safe disposal of defense-generated TRU and mixed waste in a geologic repository. The Salado Formation of Permian age serves as the repository medium. The Salado Formation consists of bedded salt and associated evaporites. The formation is 602 meters thick at the site area; the top surface is located at a subsurface depth of 262 meters (10). The repository lies at a subsurface depth of 655 meters. Water-quality sampling for physical, chemical, and radiological parameters has been an ongoing activity at the WIPP site for the past six years, and will continue through the life of the project. Data collected from this program to date, has been used by Sandia National Laboratories for site characterization and performance assessment work. The data has also been used to establish a baseline of preoperational radiological and nonradiological groundwater quality. Once the facility begins receiving waste, this baseline will be used to determine if the WIPP facility influences or alters groundwater quality over time. The water quality of a well is determined while the well is continuously pumped. Serial samples of the pumped water are collected and tested for pH, Eh, temperature, specific gravity, specific conductivity, alkalinity, chlorides, divalent cations, ferrous iron, and total iron. 13 refs., 4 figs., 1 tab.

42416 (CONF-900210–Vol.2, pp. 85-90) **Readiness review for site characterization: A systems approach.** Bisese, P.L. (Bechtel National Inc., Oak Ridge, TN (USA)); Cawley, C.N.; Hunter, M.A.; Sabbe, M.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Fulfilling the requirements for site characterization of a waste disposal facility may require the integration of many disciplines into a program of hydrogeologic investigations, air and water quality measurements, radiological characterization, meteorological investigations, ecological investigations, and socioeconomic studies. The preceding represent only one segment of the complex issues facing any project planning field activities. Other and more difficult aspects are related to (1) defining and integrating the tasks to prevent duplication and increased costs, thereby promoting efficiency,

(2) organizing and understanding the system of contracts that either support or direct performance of tasks, (3) identifying the procedures which control performance of work in the field and in the office, and (4) gaining concurrence among those responsible for the work that field activities will be managed and administered in a specified manner. A graphic representation of the system to perform site characterization was the focus for the readiness review. It was effective in (1) identifying procedures which needed to be developed or expanded to support or include an activity, (2) defining scopes of work and responsibilities of various contractors, (3) identifying deficiencies in a complex system of responsibilities and contractors, and (4) developing a consensus and understanding of how field activities would be administered, controlled, and managed. A general description of the systems approach may help other projects in planning and organizing field activities. 1 ref., 5 figs.

42417 (CONF-900210–Vol.2, pp. 91-98) **Facilities for processing, packaging and storage of intermediate level radioactive waste at the Winfrith Technology Center.** Lloyd, A.I.; Price, M.S.T.; Staples, A.T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The UK strategy for the management of radioactive waste is the responsibility of the Secretary of State for the Environment. The implementation of that strategy is a function of Her Majesty's Inspectorate of Pollution (HMIP), a department within the Department of the Environment. Close liaison between HMIP and Her Majesty's Nuclear Installation Inspectorate (HMNII) takes place ensuring that site licenses are only granted for proposals which are consistent with the national waste management strategy. The task of developing national low level solid waste (LLSW) and intermediate level waste (ILW) disposal facilities rests with the UK Nirex, Ltd., a company formed by major national nuclear utilities with independent and government representation. This company is currently investigating the suitability of Sellafield, Cumbria and Dounreay, Caithness for a national repository. Operation of such a facility is unlikely however before the year 2005. 6 refs., 2 figs., 2 tabs.

42418 (CONF-900210–Vol.2, pp. 99-110) **Results of field testing of waste forms using lysimeters.** McConnell, J.W. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)); Rogers, R.D. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The TMI-2 EPICOR-II Resin/Liner Low-Level Waste Data Base Development Program, funded by the U.S. Nuclear Regulatory Commission (NRC), is obtaining information on the performance of radioactive waste in a disposal environment. Waste forms fabricated using ion-exchange resins from EPICOR-II prefilters employed in the cleanup of the Three Mile Island Nuclear Power Station are being tested to: (a) develop a low-level waste data base, and (b) obtain information on survivability of waste forms in a disposal environment. This paper updates field testing of those waste forms during FY-1989. The results of the lysimeters are presented and the use of lysimeter data in performance assessment is discussed. 16 refs., 10 figs., 5 tabs.

42419 (CONF-900210–Vol.2, pp. 19-22) **Developing an ANSI [American National Standards Institute] standard for semitrailers used to transport radioactive materials.** Gregory, P. (Westinghouse Electric Corp., Carlsbad, NM (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A proposed new American National Standards Institute (ANSI) standard has been prepared which establishes requirements for the design, fabrication, and maintenance of semitrailers used in the highway transport of weight-concentrated radioactive loads. A weight-concentrated load is any payload which exceeds 1,488 kilograms per lineal meter (1,000 lb/ft) over any portion of the semitrailer. The proposed standard also provides detailed procedures for in-service inspections, as well as requirements for testing and quality assurance. The standard addresses only semitrailers, excluding the tractor. Trailers already in service may be certified as complying with the standard if they meet the requirements of the standard. This standard is intended to provide guidance and acceptance criteria needed to establish a uniform minimum level of performance for the designer, manufacturer, owner, operator, and shipper. This standard is not intended to apply to special, nonroutine shipments of a one-time or occasional nature which require special permitting. The background and history of the standard are traced and a summary discussion of the standard is provided in this article.

42420 (CONF-900210–Vol.2, pp. 57-62) **Leaching ratio from pellet package.** Yui, Kohei (Japan Atomic Power Co., Tokyo (Japan)); Suzuki, Nagao; Matsunaga, Masaaki; Chino, Koichi; Funabashi, Kiyomi; Kikuchi, Makoto. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Radioactive concentrated liquid waste is dried and compressed into pellets. These pellets are solidified as a package, by pouring a solidifying agent into the spaces between them. This paper studies a leaching model for the pellet package and calculated results of the model are compared with long term experimental results, which were obtained using Na_2SO_4 pellets and cement-glass for a solidifying agent. The following conclusions are obtained: Diffusion coefficients and distribution factors can be evaluated by the volumetric average of cement-glass and pellet properties. Calculated results agreed with experimental ones obtained for a period of more than 600 days. The leaching ratio from a 200l pellet package could be estimated as 3×10^{-6} for the first year due to the low diffusion coefficient of the PIC barrier. 4 refs., 8 figs.

42421 (CONF-900210–Vol.2, pp. 63-68) **Effects of varying recharge on radionuclide flux rates to the water table at a low-level solid waste burial site.** Khaleel, R. (Westinghouse Hanford Co., Richland, WA (USA)); LeGore, T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public

education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Numerical simulations were conducted to model flow and transport from a low-level solid waste burial site at the Hanford Site in southeastern Washington. Solid waste burial trenches are located in the 200 Areas near the soil surface, above the water table. A heterogeneous, layered soil profile representative of the 200 Area soils was used in the simulations. Three recharge rates (0.05, 0.5, and 5.0 cm/yr) were considered. At the low recharge rate (0.05 cm/yr), diffusive transport in the horizontal direction was much larger than the computed flux to the water table. With an increase in the recharge rate, the computed flux rates to the water table were much higher than those computed for the right boundary. An increase in the recharge rate from 0.05 cm/yr to 5 cm/yr resulted in the transformation of a diffusion-dominated problem into an advection-dominated one. 4 refs., 7 figs., 3 tabs.

42422 (CONF-900210–Vol.2, pp. 111-124) **BLT [Breach, Leach, and Transport]: A source term computer code for low-level waste shallow land burial.** Suen, C.J. (Brookhaven National Lab., Upton, NY (USA)); Sullivan, T.M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

We developed a source term model for low-level waste shallow land burial facilities by separating the problem into four individual compartments: (1) water flow, (2) corrosion and subsequent breaching of containers, (3) leaching of the waste forms, and (4) solute transport. For the first and the last compartments, we adopted the existing codes, FEMWATER and FEMWASTE, respectively. We wrote two new modules for the other two compartments in the form of two separate Fortran subroutines - BREACH and LEACH. They were incorporated into a modified version of the transport code FEMWASTE. The resultant code, which contains all three modules of container breaching waste form leaching and solute transport, was renamed BLT (for Breach, Leach, and Transport). This paper summarizes the overall program structure and logistics, and presents two examples from the results of verification and sensitivity tests. 6 refs., 7 figs., 1 tab.

42423 (CONF-900210–Vol.2, pp. 125-130) **The migration of ceslum-137 through cement formulations applicable to radioactive waste management.** Rudin, M.J. (Purdue Univ., West Lafayette, IN (USA)); Landolt, R.R. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

An experimental method was developed to measure the penetration of radioactivity through cementitious barrier materials applicable to radioactive waste management. The technique was used to test eighteen portland cement formulations containing three levels of cement/fly ash content (100%/0%; 85%/15%, and 60%/40%), two levels of water to cementitious solids ratio (w/s = 0.33 and 0.43) and three levels of additive (none, silica fume, and latex polymer). Each formulation was molded into a solid cement specimen containing a centered well space which served as a reservoir for the Cs-137 solution. After a predetermined time period the Cs-137 solution was removed and a 2-cm long by 1.27-cm diameter cement core was extracted from the monolith well bottom using a diamond core drill. Each cement core was then cut into successive horizontal slices using a diamond saw blade. The Cs-137 activity in each cement slice was determined with a NaI(Tl) detector connected to a single channel analyzer. Analysis of variance (ANOVA) and regression models were used to examine, the statistical relationship between the different formulations in terms of the Cs-137 activity in the cement slices versus the migration distance as indicated by the respective slice depths. The generation of regression curves allowed the comparison between different cement formulations and their relative ability to effectively retard the migration of the Cs-137. The results indicate that mixes incorporating 5% silica fume (EMSAC) at a w/s ratio of 0.33 are more effective at retarding Cs-137 migration compared to the other formulations tested. Those mixes exhibited high Cs-137 uptake in the slices in contact with the Cs-137 well solution and a dramatic decrease in Cs-137 activity in successive slices compared to other mixes. 5 figs., 1 tab.

42424 (CONF-900210–Vol.2, pp. 131-138) **Low-level waste shallow land burial source term container breach and waste form leaching model development.** Sullivan, T.M. (Brookhaven National Lab., Upton, NY (USA)); Suen, C.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A general computer model has been developed to predict the release and transport (i.e. source term) of radionuclides from shallow land burial facilities. This model predicts the processes of unsaturated water flow, metallic container degradation, leaching of radionuclides from the waste form, and their movement away from the waste form. This paper discusses model development work for the container degradation and leaching aspects of the source term model. Application of these models and the sensitivity of release rates to model parameters, e.g. diffusion coefficients, corrosion rates, etc., are also discussed. 14 refs., 2 figs.

42425 (CONF-900210–Vol.2, pp. 139-152) **Retrieval of nuclear waste from a land based deep repository.** Myall, M.G.; Hughes, A.F. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The current conceptual design for the UK land based deep repository is one in which waste packages are grouted into large caverns as emplacement proceeds. All such waste will ultimately be retrievable and indeed it is recognized that there could be a requirement to retrieve waste packages for social, political or technical reasons but this has to be achieved without prejudicing long term safety. A feasibility study has been carried out to determine methods of retrieval and the implications in terms of repository operation, repository costs, safety and overall program. Consideration has been given to methods of retrieving waste packages from the current repository design and from designs which have been

adapted to aid retrieval. An essential precursor to retrieval is the ability to monitor the waste to show that retrieval is necessary and the study has also outlined waste monitoring methods for a number of scenarios. The paper leads to the conclusion that significant improvements could be made to the current repository design to enhance retrieval but these would result in cost penalties associated with lower packing efficiencies and the need for additional underground space. There would also be a penalty associated with the radiological dose commitment to workers involved in the retrieval operation. 1 ref., 10 figs., 2 tabs.

42426 (CONF-900210–Vol.2, pp. 153-158) **Demonstration of chemical treatment process development designed to generate a below regulatory concern (BRC) waste from radiological and mixed wastes.** Brady, D.H. (EcoTek, Inc., Erwin, TN (USA)); Carlson, B.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

EcoTek, Inc., has performed numerous process development treatability studies designed to develop chemical treatment processes to extract radionuclides from both radiological and mixed waste sediments, sludges and soils. The primary purpose of process development studies for radiological and mixed wastes is to cost effectively produce a leached residue activity which is consistently BRC. An optimum treatment process which generates a BRC residue allows alternate disposal options for both waste types as either a non-radiological, or hazardous waste. Secondary process development objectives are to identify resource recovery potential from residue and aqueous waste streams, minimize waste stream volumes and avoid generating waste streams which are characteristic hazardous wastes. The treatment process identified for each waste type has been successfully demonstrated at bench and pilot scale levels. Results of two process development treatability studies for a radiological and a mixed waste are outlined below. The radiological waste was a uranium bearing fuel fabrication waste in a calcium fluoride matrix. A sulfuric acid leaching process was developed for this waste which produced a residue activity allowing disposal in a chemical landfill. This process also selectively recovers uranium from the leachate for recycle back to the fuel fabrication cycle. A pilot plant is under construction. A sulfuric acid leaching process was developed for a mixed waste soil contaminated with uranium, thorium, PCB, heavy metals, and other listed hazardous organics. The process was optimized on a laboratory scale basis and demonstrated via laboratory and large scale batch tests. The optimum treatment process produced a residue total activity upper limit (95% UL) below 34 $\mu Ci/m^3$ (36 pCi/g). Total activity was defined as the sum of gross alpha + gross beta + gross gamma activities. 2 refs., 1 fig., 1 tab.

42427 (CONF-900210–Vol.2, pp. 159-166) **Development of an integrated assay facility.** Molesworth, T.V. (Taylor Woodrow Management & Engineering Ltd., Hayes (England)); Bailey, M.; Findlay, D.J.S.; Sene, M.R.; Swinhoe, M.T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Initial results of active neutron and active gamma-ray interrogation of a 500 liter cemented simulated CAGR intermediate level radioactive waste drum are described. The basis of the interrogation systems was the Harwell electron linear accelerator HELIOS, which was used to produce the interrogating neutrons and gamma-rays. Several sets of neutron detectors were located around the drum to count signature neutrons. The responses of the system were measured by placing known samples at many different locations within the drum. In general, measured responses confirmed calculated responses. Good agreement was obtained for the azimuthal angle dependences. The absolute responses agreed well for gamma-ray interrogation, but the calculations were apparently over-estimates for neutron interrogation. Those aspects requiring consideration in the practical application of assay techniques are identified. 8 refs., 6 figs.

42428 (CONF-900210–Vol.2, pp. 167-172) **Below regulatory concern standards: The limits of state and local authority.** Silverman, D.J. (Newman & Holtzinger, Washington, DC (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The paper discusses: (1) the scope of the Nuclear Regulatory Commission's authority to develop and implement below regulatory concern or BRC standards; and (2) the limitations on the legal authority of states and local governments to create impediments to full implementation of such standards. The paper demonstrates that the NRC is acting well within its statutory authority in developing BRC regulations and guidelines, and that the ability of state and local governments to impede generators' use of those regulations and guidelines on the basis of legal or regulatory initiatives is substantially circumscribed. While some generators may be reluctant, as a result of political factors, to utilize BRC standards, the decision whether or not to use such standards should not be made without careful consideration of the applicable legal and regulatory limitations on state and local authority.

42429 (CONF-900210–Vol.2, pp. 173-178) **Challenges in characterizing low-level radioactive waste for new disposal facilities.** Baird, R.D. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)); Shuman, R.; Merrell, G.B.; Rogers, V.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Under the requirements of 10 CFR 61 it is necessary to characterize low-level radioactive waste (LLW) expected to be disposed in new LLW disposal facilities. Analyses are required to demonstrate that the disposal facility will meet 10 CFR 61 performance objectives. Although no regulations exist that define the level of detail required for the waste characterization the data requirements for the required performance assessments set the standard. Current publicly-available information sources do not provide sufficiently discrete data for LLW waste streams to allow waste to be adequately characterized. Surveys of generators' records may be necessary to provide the necessary information. 12 refs., 3 tabs.

42430 (CONF-900210–Vol.2, pp. 179-186) **Advanced disposal technologies for new low-level waste disposal compact**

sites. Anderson, R.T. (Chem-Nuclear Systems, Inc., Columbia, SC (USA)); Barnhart, V.J.; Ryan, M.T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A number of low-level radioactive waste disposal sites will start operation in the 1990'5. Typically, these sites will employ advanced disposal technologies. These technologies will increase confidence in the safe disposal of waste for hundreds of years following site closure. The disposal procedures will utilize engineered barrier technology in addition to the protection offered by the waste form and the disposal site itself. This paper presents an overview of the disposal technology being used by Chem-Nuclear Systems, Inc. (CNSI) in the design and development of three of the largest U.S. commercial LLW sites. Specific discussion is included on design philosophy, materials of constructor, and special safety features. The CNSI approach is representative of the advanced LLW disposal technology that will be practiced in the U.S. over the next 20-50 years. 3 figs., 3 tabs.

42431 (CONF-900210–Vol.2, pp. 187-192) **License application approach for the California LLRW disposal facility.** Gaynor, R.K. (US Ecology, Inc., Newport Beach, CA (USA)); Romano, S.A.; Hanrahan, T.P. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

US Ecology, Inc. is the State of California's license designee to site, develop and operate a low-level radioactive waste (LLRW) disposal facility to serve member states of the Southwestern Compact. US Ecology identified a proposed site in the Ward Valley of southeastern California in March 1988. Following proposed site selection, US Ecology undertook studies required to prepare a license application. US Ecology's license application for this desert site was deemed complete for detailed regulatory review by the California Department of Health Services (DHS) in December 1989. By mutual agreement, disposal of mixed waste is not proposed pending the State of California's decision on appropriate management of this small LLRW subset.

42432 (CONF-900210–Vol.2, pp. 193-196) **California's review of US Ecology's low-level radioactive waste license application.** Womeldorf, D.J. (California Dept. of Health Sevices, Sacramento (USA)); Junkert, R.; Huck, R.O. Jr. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The California Department of Health Services, under federal and state statutory mandate, is the lead agency for licensing and regulating the Southwestern Compact's low-level radioactive waste disposal facility. US Ecology has submitted a license application for disposal of all low-level radioactive waste except mixed waste. The Department uses contractors and ad hoc groups to supplement its own staff to perform work related to issuing the license and overseeing operations. The license is to be issued in 1991, at which time operations will commence. Mixed waste disposal is being addressed separately. California's actions to license a low-level radioactive waste (LLRW) disposal facility are set against a background of federal and state legislation. The California Legislature attempted in 1982 to pass LLRW disposal legislation in response to the 1980 federal LLRW Policy Act (PL 96-573), but the first try, resulted only in interim storage authority being granted to the State. A comprehensive statute was enacted in 1983, which mandated the State to establish a disposal facility, instructed the Governor to seek compact partners named the Department of Health Services as lead agency and defined its duties, and instructed the Department to select, by a competitive process, a private firm as license designee. The proposed facility is located in the Ward Valley, about 25 miles west of Needles, San Bernardino County. The Department will have full regulatory and rate setting authority over disposal of low-level radioactive waste generated by Arizona, California, North Dakota, and South Dakota. California and the Compact's actions are geared to meet the requirements of the 1985 Low-Level Radioactive Waste Policy Amendments Act (PL 99-240). This paper describes the actions taken by the Department associated with its regulatory responsibilities.

42433 (CONF-900210–Vol.2, pp. 197-202) **LLRW disposal: Economies of scale and half-life segregation.** Bullard, C.W. (Univ. of Illinois, Urbana-Champaign (USA)); Weger, H.T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This report examines the underlying cost structure of an advanced LLRW disposal technology designed for the State of Illinois: concrete canisters placed in an above-ground, earth-mounded concrete vault. It explores opportunities for reducing the overall cost of disposal by segregating the relatively short-lived Class A waste from long-lived Class B&C wastes, and quantifies the cost advantage as a function of the discount rate. The site consolidation issue is also addressed by examining the relative magnitudes of the fixed and variable costs. The difference between having three and ten disposal sites to handle the U.S. waste stream is estimated to average $150 million annually, 12 refs., 4 figs., 4 tabs.

42434 (CONF-900210–Vol.2, pp. 203-208) **Low-level radioactive waste disposal licensing and regulations in Pennsylvania.** Dornsife, W.P.; Saraka, L.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Pennsylvania will implement its Low-Level Radioactive Waste Policy Amendments Act responsibilities through the regional compacting process. As a host state, it has the duty to establish disposal capacity for low-level wastes generated within the

Appalachian Compact. The Pennsylvania Department of Environmental Resources is developing a comprehensive oversight program to regulate, license and permit all activities associated with disposal facility development and operation. Lessons learned, public involvement initiatives and results, and implementation concerns are discussed within the context of developing this oversight program.

42435 (CONF-900210–Vol.2, pp. 209-218) **Performance assessment of the potential low-level radioactive waste disposal site in Texas.** Charbeneau, R.J. (Univ. of Texas, Austin (USA)); Hertel, N.E.; Becker, M.; Pollard, C.G. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Texas Low-Level Radioactive Waste Disposal Authority is completing two years of detailed on-site suitability studies of a potential low-level radioactive waste disposal site in Hudspeth County, Texas. The data from these studies have been reduced to the necessary site specific parameters needed to do a performance assessment of the site. The radiological impacts of the site have been analyzed as would be required for a license application. The methodologies employed and some results of the site characterization and performance assessment, especially as they relate to vadose zone pathways, are presented. 8 refs., 2 figs., 2 tabs.

42436 (CONF-900210–Vol.2, pp. 221-228) **Advanced LLW classification system.** Yagi, T. (JGC Corp., Tokyo (Japan)); Yamazaki, H.; Yokota, A.; Kuribayashi, H. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In the land disposal of low-level radioactive waste (LLW) in Japan it is legally required that the concentration of each nuclide in the waste package be confirmed at each existing power station. The scaling factor method has been investigated as the optimum method of estimating the concentration of each nuclide. It has become necessary to develop a simple analytical method to determine the scaling factor because radiochemical analysis has been proved to be both difficult and expensive, requiring much time and manpower. JGC has developed an advanced LLW classification system to confirm the concentration of each nuclide. The system consists of a new radionuclide-analysis system (IC-ICPMS), a scaling factor estimation system (computer code) and a direct assay system (gross gamma method). The system can accurately evaluate the radioactivity of the waste, improve the detectable limit and reduce the work volume required for measurement, compared with previous manual radiochemical analysis. 5 figs., 1 tab.

42437 (CONF-900210–Vol.2, pp. 229-234) **Classification of contaminated and neutron-activated concretes from nuclear facilities prior to their decontamination or decommissioning.** Angus, M.J. (AEA Technology, Cumbria (England)); Hunter, S.R.; Ketchen, J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A good estimate of the radioactivity in a nuclear facility is required to define the approach to decommissioning in terms of method and timing. A series of concrete core samples have been taken from various aging nuclear facilities. These include a cooling pond, a dry concrete facility and a reactor bioshield. These samples have been examined to determine radiation levels, distribution of surface activity, depth of penetration of specific radionuclides, compressive strength as well as some microstructural examination by a scanning electron microscope. The results will provide useful information in planning decommissioning. Although activity can penetrate some distance into the concrete, the levels are very low compared to surface activity. The amount of penetration depends on the surface condition of the concrete. 6 refs., 7 figs., 1 tab.

42438 (CONF-900210–Vol.2, pp. 235-238) **Nuclear waste drum assayer.** Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA (USA)); Turner, P.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper describes a completely transportable, one-man-operable nuclear waste drum assayer capable of determining the concentrations of all radioisotopes in the drum. The principal radiation measuring devices are a segmented gamma-ray spectrometer utilizing a collimated germanium diode detector and two banks of neutron-sensitive proportional counters nearly surrounding the rotating drum. The neutron counters provide a sensitive measure of the transuranic activities present, and the germanium spectrometer provides a quantitative determination of the gamma-ray emitting radioactivities. The bremsstrahlung radiation from 90Sr is also measured by the germanium detector and is used to quantify this isotope. Software algorithms determine the concentrations of the so-called difficult-to-measure radionuclides based on the directly measured nuclides and operator input regarding the source waste stream. The system can quantitatively sort waste into transuranic, low-level or even the proposed new category of below regulatory concern. 4 refs.

42439 (CONF-900210–Vol.2, pp. 239-246) **Development of non-destructive actinide assay methods for radioactive waste.** Armitage, B.H.; Lambert, K.P.; Swinhoe, M.T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The need to measure the actinide content of radioactive waste has led to the development at Harwell of a range of radioactive waste assay equipment. This paper describes the current status of a number of Harwell standard assay systems, giving the performance and limitations of passive gamma, passive neutron and active neuron interrogation systems. Methods have been developed to correct for the effects of the waste matrix material on the

measurements. Other techniques are being developed to tackle the problem of the self-shielding in lumps of fissile material. 5 refs., 7 figs., 2 tabs.

42440 (CONF-900210–Vol.2, pp. 247-254) **Low-level radioactive waste research program plant.** Lambert, J. (Nuclear Regulatory Commission, Washington, DC (USA)); O'Donnell, E.; Silberberg, M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Office of Nuclear Regulatory Research, has developed a strategy for conducting research on issues of concern to the U.S. Nuclear Regulatory Commission (NRC) in its efforts to ensure safe disposal of low-level radioactive waste (LLW). The program plan has been published in NUREG-1380, and provides an integrated framework to ensure that the program and its products are responsive and timely. The plan addresses technical and scientific issues and uncertainties associated with the disposal of LLW, presents goals and ways for achieving them, establishes a long-term strategy for the confirmatory and investigative research needed and includes schedules and milestones for completion. Areas for investigation include waste form and other material concerns, failure mechanisms and radionuclide releases, engineered barrier performance, site characterization and monitoring, and performance assessment. The plan includes projects that (1) analyze and test actual LLW and solidified LLW under laboratory and field conditions to determine leach rates and radionuclide releases, (2) examine the radiological and chemical characteristics of decommissioning waste from Nuclear power stations, (3) examine the short- and long-term performance of concrete-enhanced LLW burial structures and high-integrity containers, (4) investigate the long term effectiveness of disposal unit covers in controlling water infiltration into disposal units, (5) examine the information needed at time of closure for predicting future facility performance, (6) attempt to develop a predictive model of the rate of radionuclide release at the boundary of waste disposal units, (7) examine radionuclide transport behavior, pathways, uptake, and transfer coefficients of radionuclide releases from LLW disposal facilities, and (8) attempt to predict water movement and contaminant transport through low permeability saturated media and unsaturated porous media. 1 fig.

42441 (CONF-900210–Vol.2, pp. 255-260) **TMI-2 waste management experience.** Deltete, C.P. (Analytical Resources, Inc., Sinking Spring, PA (USA)); Hahn, R.E.; Conaway, W.T.; Lambert, R.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

One of the main areas of both regulatory and public concern surrounding the cleanup at TMI-2 was the packaging shipment, and disposal of radioactive waste. Through the end of 1989, approximately 183,200 cubic feet of radioactive waste was disposed of as a result of cleanup activities. To transport this volume to various disposal locations required in excess of 500 radioactive material shipments involving over 7,500 separate waste containers. The majority of these shipments required use of NRC certified shipping containers while the remainder were shipped by either flatbed or closed van trailers. In order to provide a comprehensive documentation of the important aspects of the waste management activities resulting from the TMI-2 recovery program GPU Nuclear Corporation (GPUN) and the Electric Power Research Institute (EPRI) established a program of Technology Transfer in the area of waste management. The report that was prepared as a result of this effort provides a historical perspective by documenting the volume and characteristics of the waste that was generated. The report also discusses numerous waste management problems identified during the cleanup, and solutions developed by the TMI-2 Staff in handling the problems that arose.

42442 (CONF-900210–Vol.2, pp. 261-266) **Identification and characterization of Department of Energy special-case radioactive waste.** Williams, R.E. (EG & G Idaho, Inc., Idaho Falls (USA)); Kudera, D.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper identifies and characterizes Department of Energy (DOE) special-case radioactive wastes. Included in this paper are descriptions of the special-case waste categories and their volumes and curie contents, as well as discussions of potential methods for management of these special-case wastes. Work on extensive inventories of DOE-titled special-case waste are still in progress. 1 tab.

42443 (CONF-900210–Vol.2, pp. 267-274) **The effect of count time on reliably detectable activity (RDA) when assessing contamination monitoring performance.** Hassig, N.L.; Wanless, J.W.; Phillips, L.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Radiation monitoring equipment can see or detect only source activity greater than background. This paper explores the methods used to determine the minimum detectable activity (MDA) of such equipment. Under experimental conditions, known sources of low-level radiation were counted. The predetermined MDA was compared to the lowest level of known sources detectable by the equipment. It is shown that most currently used MDA equations correctly predict the minimum detectable source level. However, the MDA levels predicted by theoretical equations, without taking excess variability (high background, unstable background) into consideration, may be lower (i.e., indicate smaller sources are detectable) than is actually possible with the equipment and measuring procedures as defined. 6 refs., 4 figs., 4 tabs.

42444 (CONF-900210–Vol.2, pp. 277-282) **Spent resin sample device - the rain gauge.** Presgrove, S.B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology:*

Proceedings. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

During construction of a 2-1250 MWt Westinghouse plant an assignment was given to provide a means to sample spent resin prior to shipment as defined in USNRC Regulatory Guide 1.21 (1). No guidelines or limitations were given as to method or expense. A goal was established to provide a truly representative sample of spent resin. The two existing methods of sampling were reviewed and determined to be either too expensive or unable to provide a truly representative sample. The new design provides that representative sample capability at minimal cost in dollars, man hours and Man Rems. 2 refs., 8 figs.

42445 (CONF-900210–Vol.2, pp. 283-294) **Degradation of resins in EPICOR-II prefilters from Three Mile Island.** McConnell, J.W. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)); Johnson, D.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC07-76ID01570. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings*. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Low-Level Waste Data Base Development–EPICOR-II Resin/Liner Investigation Program funded by the U.S. Nuclear Regulatory Commission is investigating the chemical and physical conditions of the synthetic ion exchange resins contained in several EPICOR-II prefilters. Those prefilters were used during cleanup of contaminated water from the Three Mile Island Nuclear Power Station after the March 1979 accident. This paper summarizes results and analyses of the third sampling of resins from prefilters PF-8 and -20. Results are compared with baseline data from tests performed on unirradiated resins supplied by Epicor, Inc. to determine if degradation has occurred due to the high internal radiation dose. Results also are compared with results from tests performed on resins obtained from the first and second samplings of those two prefilters. 17 refs., 4 figs., 4 tabs.

42446 (CONF-900210–Vol.2, pp. 295-298) **Full-scale performance of new organic resin ratios and inorganic materials for processing low level liquids at Diablo Canyon Power Plant.** James, K.L.; Miller, C.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings*. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper discusses Pacific Gas and Electric Company's full-scale operating experience using new ion exchange resins and rations for processing radioactive liquids at Diablo Canyon Power Plant (DCPP). Previous tests investigated new organic resins, various resin ratios and several ion selective inorganic media for processing nonrecyclable and recyclable plant liquids. The data from those bench scale tests indicated how processing liquids at DCPP could be improved. Information obtained from the bench scale tests have been directly applied to full-scale operation throughout 1989. Processing nonrecyclable and recyclable liquids prior to the bench scale tests utilized a 50:50 mixed bed (Amberlite IRN-150) ion exchange resin. The full-scale test of new media effectively processed more liquid at higher conductivities than previously experienced. Optimizing the cation and anion ratios has improved the removal of radionuclides and chemical species for specific liquid streams. The use of polyelectrolyte pretreatment in full-scale processing has enhanced the radionuclide decontamination for nonrecyclable liquids. The combination of these applications has improved the ion exchange process for treating nonrecyclable and recyclable liquids at DCPP. 1 ref., 2 figs., 1 tab.

42447 (CONF-900210–Vol.2, pp. 299-304) **Advanced cement-solidification process for spent ion-exchange resins.** Sauda, K. (JGC Corp., Yokohama (Japan)); Todo, F.; Nakashima, T.; Kagawa, T.; Kuribayashi, H. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings*. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

JGC has developed an advanced cement-solidification process (AC-Process) for the treatment and stabilization of radioactive spent ion-exchange resins generated at nuclear power plants. The AC-Process can produce excellent products in comparison with other existing cement solidification processes. In addition, this process requires a lower operating cost than that of the HIC system. In general, cement-solidification products derived from spent ion-exchange resins tend to swell in water. Such swelling is caused by the expansion of resins in water due to the absorption of water and by the adsorption of soluble contents in the cement matrix. In order to solve this problem JGC has developed a new pretreatment technique for obtaining cement-solidified products which will meet the requirements for final disposal. Extensive tests were conducted to determine pretreatment conditions. The properties of obtained products were evaluated to verify that they met the requirements for final disposal. The results of the tests and evaluation are reported below. 1 ref., 2 figs., 1 tab.

42448 (CONF-900210–Vol.2, pp. 305-312) **Liquid radwaste process optimization at Catawba Nuclear Station.** Cauthen, B.E. (Duke Power Co., Charlotte, NC (USA)); Taylor, J.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings*. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Since commercial operation in 1985, Catawba Nuclear Station has experienced significant filtration problems with the radioactive liquid waste system. The performance of the filtration and ion exchange equipment has been significantly worse than other Duke Power stations. Full scale tests have been performed to investigate the causes and potential solutions to the waste processing difficulties. The initial waste stream characterization study revealed a large percentage of sub-micron particles. This information immediately suggested that the existing filtration equipment was not adequately sized to effectively process the waste stream. New technologies which would effectively enhance the performance of the processing system and reduce both operating and maintenance costs were researched. This included bag filters, depth filtration, custom designed ion exchange vessels and radionuclide specific ion exchange media. The subsequent full scale testing resulted in a processing scheme which resulted in extended filter life, over 100 percent increase in ion exchange bed life, 90 percent reduction in filter media costs and improved radionuclide removal. 4 refs., 4 figs., 1 tab.

42449 (CONF-900210–Vol.2, pp. 313-316) **Dewatering of sludge by enhanced electro-osmosis.** Shoji, Yuichi (Toshiba Corp., Tokyo (Japan)); Matsuura, Hiroyuki; Wada, Mikio. American

Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Laboratory scale tests are being conducted to optimize enhanced electro-osmotic dewatering (EED) for fine suspensions, which are simulated as the sludge waste generated from nuclear power stations; the mixture of powdered ion exchange resin and iron compound. The test shows that the EED increases the dewatering rate and decreases the final moisture content in the sludge, as compared to gravimetric dewatering. The EED method is a combination of conventional electro-osmotic dewatering and the action which hydrated Na^+ ions are forced to transfer in the electric field that is, water molecules are moved in the sludge by the Na^+ ions. It has been proved that the marriage of the two dewatering mechanisms enhanced the dewatering rate and overall moisture reduction. 2 refs., 9 figs., 2 tabs.

42450 (CONF-900210–Vol.2, pp. 317-322) **Radioactive liquid waste volume reduction systems.** Williams, R. (Pacific Nuclear Systems, Inc., Columbia, SC (USA)); Strand, G. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The basis of this paper is to discuss the development and operation of Pacific Nuclear System's RVR-7200 System. The RVR-7200 was developed for use at Three Mile Island (TMI) Unit II for processing of radioactive water resulting from the 1979 accident. The contaminated water was produced from direct releases of reactor coolant during the accident as well as primary coolant leakage and in leakage of river water through the reactor building air coolers. Additional water was generated during defueling and decontamination activities during the post accident years. 1 ref., 1 fig., 1 tab.

42451 (CONF-900210–Vol.2, pp. 323-326) **Waste dewatering process improvements at Brunswick Steam Electric Plant.** Sellers, L. (Carolina Power & Light Co., Southport, NC (USA)); Roy, B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In September 1989, Brunswick Steam Electric began with a new waste contractor and compression dewatering system to process the plant's spent powdered and bead ion exchange resins. The waste processing contract included incentives and penalties related to waste volume reduction performance and total processing costs to the plant. This was the first commercial use of its compression dewatering system by the contractor, Westinghouse Radiological Services, Inc. (now part of the Scientific Ecology Group, Inc.). The installation at Brunswick was made in the existing four-cubicle outdoor processing area. The system controls and monitoring are remote. Operating experience to date includes five powdered resin containers and eight bead. Volume reductions of powdered resin wastes indicate a 80% improvement over recent previous processing experience at the plant. Processing times on a per cubic foot of resin processed have been deceased by faster dewatering and less container handling. The dewatered and consolidated waste product characteristics (dry weight percent, density, lack of free water) have been very consistent. 4 figs.

42452 (CONF-900210–Vol.2, pp. 327-330) **Rapid analysis of non-gamma radionuclides using the ANABET [ANalysis of Alpha, Beta and Electron-capture radionuclide Technology] system.** Bradbury, D.; Elder, G.R.; Dunn, M.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Analysis of radionuclides that do not emit a gamma ray has traditionally been a difficult task. Where complex mixtures of isotopes are present extensive chemical separation usually has to be performed prior to radiometric analysis in order to achieve proper identification and quantitative analysis of the isotopes of interest. The ANABET system (ANalysis of Alpha, Beta and Electron-capture radionuclide Technology) is a method for achieving the separation and quantitative measurement in a single step. To do this ionic constituents of the sample are separated by ion exchange chromatography, and the resulting fractions or peaks of separated nuclides pass sequentially through an on-line scintillation detector for quantitative measurement. 2 figs., 2 tabs.

42453 (CONF-900210–Vol.2, pp. 331-338) **Observed TRU data from nuclear utility waste streams.** Wessman, R.A. (TMA/Norcal, Richmond, CA (USA)); Floyd, J.G.; Leventhal, L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

TMA/Norcal has performed 10CFR61 analysis of radioactive waste streams from BWR's and PWR's since 1983. Many standard and non-routine sample types have been received for analysis from nuclear power plants nation-wide. In addition to the 10CFR61 Tables I and II analyses, we also have analyzed for many of the supplementary isotopes. As part of this program TRU analyses are required. As a result, have accumulated a significant amount of data for plutonium, americium, and curium in radioactive waste for many different sample matrices from many different waste streams. This paper will present our analytical program for 10CFR61 TRU. The laboratory methodology including chemical and radiometric procedures is discussed. The sensitivity of our measurements and ability to meet the lower limits of detection is also discussed. Secondly, a review of TRU data is presented. Scaling factors and their ranges from selected PWR stations are included. We discuss some features of, and limits to, interpretation of these data. 8 refs., 3 tabs.

42454 (CONF-900210–Vol.2, pp. 339-346) **Global positioning site environment evaluator.** Leffler, S. (Sorrento Electronics,

San Diego, CA (USA)); Reeser, H.G.; Zaker, E.; Hansen, W.; Sikorski, R.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Development of an innovative, integrated, automated system (Global Positioning Site Environment Evaluator - GPSEETM) for surveying contaminated waste sites is described. This system makes novel use of the Global Positioning System (GPS) satellite constellation for establishing specific locations and current times for surveying radioactive, hazardous, or mixed-waste sites. GPSEE may also be used for waste site contamination surveys after remediation activities to ensure environmental remediation is complete. A base station is established for collecting and recording data and directing field operations for field stations which may be located many miles from the base station. The field operators collect site surveying and contamination data utilizing a variety of chemical and radiological sensors. A major goal for the data collection process is to collect all data utilizing in situ sensors, thereby minimizing the need for collecting soil and water samples. Site contamination data is transmitted electronically to the base station for recording and processing. The GPSEE system is being developed for use at DOE/DOD and a variety of industrial facilities. 3 figs.

42455 (CONF-900210–Vol.2, pp. 347-352) **Transport systems for conditioned radioactive waste in Belgium.** Baekelandt, L.; Libon, H.; Dierckx, L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In implementing the waste management program set up by NIRAS/ONDRAF, conditioned waste packages have been standardized in order to facilitate and optimize their shipment and storage. Two transport systems have been developed for the carriage of these standardized packages. The paper gives a description of and reviews the experience with the two systems. 2 refs., 7 figs., 1 tab.

42456 (CONF-900210–Vol.2, pp. 353-358) **The influence of waste treatment, conditioning and packaging on design for disposal.** Tufton, E.P.S. (Costain-Arup-Electrowatt Consortium, Manchester (England)); Whipp, H.G.; Putte, D.V. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The design of a repository for low and intermediate level waste will always have a number of targets; safety, capacity, cost and ease of operation being prominent. Achieving the targets requires a total design of the waste management system, which ranges from treatment of the raw waste form at the source of arising to design for post-closure performance of the repository. In working on repository designs and their safety assessments, the authors have found that different waste forms have significant influences on the repository and this paper is concerned with those influences. 1 ref.

42457 (CONF-900210–Vol.2, pp. 359-362) **Processing of LLW arising from dismantling activities in a reprocessing facility.** Geens, L.G. (Belgoprocess, Dessel (Belgium)); Geens, L.P.; Vandeven, I. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Eurochemic reprocessing facility, at the Mol-Dessel site in Belgium was in active operation from July 1966 until January 1975. In total, about 210 Mg of various types of irradiated nuclear fuels were processed. After the shut-down the plant has been partially decontaminated in view of recommissioning. When the recommissioning option was abandoned, the decision was taken in 1986 to dismantle the plant. A 2 years study resulted in the start of a pilot project: the dismantling of two smaller buildings, previously used for storage of uranyl nitrate and used solvent. The minimization of radioactive waste generation was also one of the major goals of this project. The report deals with the different steps in the minimization of radioactive waste generation during the dismantling activities. First, an estimation of the amounts of radioactive waste, expected to be generated, was made. In a second step the actual waste production during dismantling operations was minimized and compared with the estimations. Finally, a large part of the primary radioactive dismantling waste has been completely decontaminated, resulting in much lower amounts of nuclear waste generated. 2 refs., 3 figs., 2 tabs.

42458 (CONF-900210–Vol.2, pp. 363-368) **Formation of hydrogen and radioactive gases in waste packages with cemented intermediate level waste.** Kroth, K. (Forschungszentrum Juelich GmbH (Germany, F.R.)); Barnert, E.; Bruecher, P.H.; Lammertz, H.; Niephaus, D. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Six 200 1 waste packages from the German pilot reprocessing plant WAK with fuel hardware, cladding hulls and dissolver sludge cemented in place were examined with respect to their radiolytic formation of hydrogen and their mobilization of volatile radionuclides. Hydrogen was found to be formed by the radiolytic disintegration of water contained in the matrix material. The specific formation rates of hydrogen partly disagree with predictions from the radiolysis of cement. Considerable amounts of Kr-85 were found to be released from waste packages with cladding hulls and dissolver sludge fixed in a cementitious matrix. The experimental results are presented and compared to theoretical expectations. 5 refs., 5 figs., 2 tabs.

42459 (CONF-900210–Vol.2, pp. 369-376) **On site storage of low level radioactive waste at Vermont Yankee.** Fuller, M.R. (Vermont Yankee Nuclear Power Corp., Vernon (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing,

transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper concerns storage of Low Level Radioactive Waste (Radwaste) at Vermont Yankee Nuclear Power Plant located in Vernon, Vermont. On January 31, 1989, Vermont Yankee was restricted from the three U.S low level radwaste burial facilities. Having anticipated this, Vermont Yankee planned to provide long term temporary storage of low level radwaste on site. This paper outlines: (1) The steps taken to establish the most cost effective method for storing the waste. (2) Performance of a 10CFR50.59 safety evaluation. (3) Preparation of the storage area and installation of storage containers. (4) Operation of the facility including dose calculations, shielding considerations, problems experienced, and advice for others who may want to pursue a similar course of action. 3 refs., 1 fig.

42460 (CONF-900210–Vol.2, pp. 377-384) **Processing of sump sludges at the Commonwealth Edison Byron Nuclear Generating Station.** Herrmann, D. (Commonwealth Edison Co., Byron, IL (USA)); Gardner, D.A.; Taylor, E.R. Jr. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A basic criterion for the disposal of radioactive waste by shallow land burial is that the material must not contain free liquids. In addition burial sites' requirements regarding radioactive waste containing oils, even though solidified, are restrictive. At Commonwealth Edison Byron Nuclear Generating Station a methodology for processing treated waste sludges, originating form the turbine building's floor drains was developed and implemented. As a result of this effort, 322 drums of oil and water sludge were processed. A dry cake, i.e., no free liquids, was produced, packaged, and readied for disposal. The dry cake contained less than 2% oil. The liquid phases resulting from the processing of the treated waste sludge were oil (that was to be processed for disposal as non-radioactive) and filtrate containing less than 5 ppm total suspended solids (TSS) and oil/grease. The filtrate TSS was below the Station's National Pollution Discharge Elimination System (NPDES) permit release limits. 4 figs.

42461 (CONF-900210–Vol.2, pp. 385-388) **Volume reduction of filter media at Susquehanna steam and electric station.** Boris, G.F. (Scientific Ecology Group, Inc., Oak Ridge, TN (USA)); Hettinger, J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper describes the joint efforts between Pennsylvania Power & Light (PPQL) and Scientific Ecology Group, Inc. (SEG) to reduce the volume of waste shipped to the burial site by the Susquehanna Steam and Electric Station (SSES) and the resulting savings realized as a result. The filter media used at SSES for its radwaste filters is composed of a mix of anion and cation powered resins, powered carbon, diatomaceous earth and a fibrous overlay. Due to the nature of this waste stream, dewatering was difficult using systems previously available in the industry. Thus, processing was accomplished by decanting (to concentrate the waste) and solidification. In the continuing effort to dewater wastes of this nature, SEG developed a new fabric filter dewatering system (RDU). To investigate its potential use in large containers, this dewatering system was installed in drum-size high integrity containers and used to test its dewatering capabilities on actual SSES waste. Promising results from these tests warranted a full-scale test. This proved successful and implementation of this processing scheme was immediate. Cost savings were substantial in transportation, burial and processing costs as well as personnel exposure. Also, additional waste volume reduction was found due to the volume reduction capability of the dewatering system (equivalent volume of new filter media approximately 1.2 times that of dewatered product volume). Additional savings resulted from SSES's continuing effort to minimize radwaste generation. Combined, these have reduced the number of shipments of filter media in 1989 to sixty percent of the number made in 1988 and have reduced costs by approximately fifty percent. 4 figs., 1 tab.

42462 (CONF-900210–Vol.2, pp. 389-398) **Low-level liquid waste decontamination by ion exchange.** Campbell, D.O. (Oak Ridge National Lab., TN (USA)); Lee, D.D.; Dillow, T.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC05-84OR21400. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Improved processes are being developed to treat contaminated liquid wastes that have been and continue to be generated at Oak Ridge National Laboratory. Both inorganic and organic ion-exchange methods have given promising results. Nickel and cobalt hexacyanoferrate(II) compounds are extremely selective for Cs removal, with distribution coefficients in excess of 106 and remarkable insensitivity to competition from Na and K. They tend to lose effectiveness at pH > - 11, but some formulations are useful for limited periods of time up to pH - 13. Sodium titanate is selective for Sr removal at high pH. The separations are so efficient that simple, batch processes can yield large DFs while generating small volumes of solid waste. A resorcinol-based resin developed at the Savannah River Site gave superior Cs removal compared with other organic ion exchangers; the distribution coefficient was limited primarily by competition from K and nearly independent of Na. The optimum pH was - 12.5. It was much less effective for Sr removal, which was limited by competition from Na. 8 refs., 4 figs., 9 tabs.

42463 (CONF-900210–Vol.2, pp. 399-406) **Phase characterization of cementitious components of a waste repository and the potential of individual phases for sorption of radioisotopes.** Aggarwal, S. (AEA Technology, Windscale, Cumbria (England)); Angus, M.J.; Tyson, A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Various cement blends have been cured over a range of temperatures to accelerate aging and have been characterized qualitatively and quantitatively to determine the phases present. Sorption measurements have been made with Cs and Pu to study

the effect of phase changes caused by accelerated curing on sorption. A series of calcium silicate hydrates (C-S-H) representing the full range of C-S-H expected to be formed in aged cements has also been prepared. Sorption measurements on these materials have been compared with sorption on cement. Sorption of Cs and Pu on C-S-H accounts for most of the sorptive properties of the cements studied. 5 refs., 2 figs., 4 tabs.

42464 (CONF-900210–Vol.2, pp. 407-412) **Q^2 - a very low level quantitative and qualitative waste assay and release certification system.** Bronson, F.L. American Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Low level radioactive waste disposal is very expensive, especially when all of the handling transportation and documentation costs are included. However for most generators, a large fraction of this low level waste is not contaminated at all, or only slightly so. The paper describes the development and performance of a low level counter that is convenient to use, and that can accurately identify and quantify the radioactivity of any gamma emitter thing that can be placed in a 55 gallon (200 liter) container. These measurement results can be used to verify the absence of radioactivity at a very low levels (10 nCi (370 Bq)/sample), and to identify the nuclides and quantities present, while differentiating against natural radioactivity (Radium, Thorium, Potassium). These results can be used as part of a 10CFR20.302 waste stream exemption program, and thus allow significant savings and a less than 1 year payback at a typical nuclear power plant. The Q1 system is fully shielded to allow it's use in the low level radwaste storage area. The detectors are either 3 Intrinsic Germanium detectors or 2 large NaI detectors. The software is fully automated for simple operation. Correlation factors can be entered to estimate non-gamma emitters from pre-established correlations to other nuclides. Typical Ge detector sensitivities are 8 nCi (300 Bq) LLD for Cs-137 at 0.8 g/cc for a 10 minute count time. NaI detector systems can achieve the same LLD in a 1 minute count. 5 figs., 1 tab.

42465 (CONF-900210–Vol.2, pp. 413-418) **Solid low level radioactive waste management within British Nuclear Fuels plc.** Johnson, L.F. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

BNFL owns and operates the principal UK solid low level waste (LLW) disposal site which is located at Drigg in West Cumbria. Disposal of LLW into shallow open cut trenches commenced in 1959. In 1987, however, BNFL announced a major program of improvements to operations at the site. This paper reviews progress to date, outlines possible future developments and describes the underlying development program. 2 figs.

42466 (CONF-900210–Vol.2, pp. 419-422) **Short-term and long-term strategies for NPP KRSKO radwaste management.** Fink, K.; Tankosic, D.; Feizullahi, F. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

All radioactive waste generated by the Nuklearna Elektrana Krsko (NEK) has been stored in a temporary storage building located at the site. In 1987, the plant owner embarked upon a program to develop and operate a low-level repository for permanent disposal of NEK waste by 1992. However, due to institutional and political considerations the schedule for the repository program has been substantially delayed. As a result, the plant owner has developed new strategies for the plant systems modifications as needed to cope with the shortage of the much needed storage and disposal space. This paper contains a presentation of these strategies and summarized the process which was used to develop them. 2 figs.

42467 (CONF-900210–Vol.2, pp. 423-427) **Valuation of cloths for decontamination by wiping.** Rankin, W.N. (Savannah River Lab., Aiken (USA)); Reif, D.J.; Fink, S.D.; Luckenbach, R.L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Treated polyester cloth was evaluated in laboratory-scale and larger-scale tests as an alternative to atomic wipes and cotton cloth for use in decontamination by wiping. The advantages of the treated polyester are as follows: Does not react with nitric acid to form unstable product, More fire resistant, Less volume of radioactive waste generated (versus atomic wipes), and Product can be recovered by soaking the polyester cloths in nitric acid. Results are that even though treated polyester wiping cloths are slightly less effective than atomic wipes and cotton cloth, its many other benefits greatly outweigh this slight disadvantage. 1 ref., 5 figs.

42468 (CONF-900210–Vol.2, pp. 429-436) **Treatment of low-activity-level process wastewaters by continuous countercurrent ion exchange.** Hall, R. (Oak Ridge National Lab., TN (USA)); Watson, J.S.; Robinson, S.M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A mobile pilot-scale continuous countercurrent ion-exchange (CCIX) system is being operated at the Oak Ridge National Laboratory (ORNL) for the treatment of wastewaters that contain predominantly calcium sodium, and magnesium bicarbonates and are slightly contaminated with ^{90}Sr and ^{137}Cs radioisotopes. A demonstration study is being conducted to evaluate the near-steady-state performance and feasibility of a pilot-scale CCIX column for the selective removal of strontium from wastewater. Test results show that the process removes strontium sufficiently from the wastewater to permit discharge while significantly reducing the volume of secondary waste generation. CCIX has the potential for effective use in several applications; however, it has not been frequently utilized by industries to date. The CCIX system

could offer an economical alternative for decontamination of wastewaters containing trace amounts of contaminants prior to discharge into the environment. This paper discusses (a) application of the Thomas model for predicting breakthrough curves from ion exchange column tests, (b) methods for scaleup of experimental small-scale ion-exchange columns to industrial-scale columns, and (c) methods for predicting effluent compositions in a CCIX system. 20 refs., 6 figs., 2 tabs.

42469 (CONF-900210–Vol.2, pp. 437-446) **Treatment and disposal of steam generator and heat exchanger chemical cleaning wastes.** Evans, D.W. (Ontario Hydro Research Division, Toronto (Canada)); Nott, B.R. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Wet air oxidation was effective in reducing the organic loading of Ontario Hydro's EDTA-based steam generator cleaning wastes and the organic acid formulation used for heat exchanger chemical cleaning. Destruction of the complexing agents resulted in direct precipitation of iron from the waste steam generator magnetite solvent and from the heat exchanger cleaning waste. The oxidized liquors contain lower molecular weight organic acids, ammonia and amines, suitable for secondary biological treatment. The oxidized copper waste requires further treatment to reduce dissolved copper levels prior to biological digestion. A preliminary evaluation of UV and ozone degradation of these wastes showed less promise than wet air oxidation. 24 refs., 1 fig., 4 tabs.

42470 (CONF-900210–Vol.2, pp. 447-456) **The application of polyelectrolytes to improve liquid radwaste treatment system radionuclide removal efficiency.** Homyk, W.A.; Spall, M.J.; Vance, J.N. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

At nuclear plants, miscellaneous waste water treated in the liquid radwaste processing system contains a significant fraction of suspended particulate materials ranging in size from a few microns down to the submicron region. The fewer particles that typically exist as colloids are generally negatively charged by virtue of inorganic and organic anions absorbed onto the particle surfaces. Because many of the radionuclides exist as colloids and resist agglomeration and settling they are not easily removed by mechanical filtration or ion exchange processes. The colloidal materials will easily pass through most filters with conventional pore size ratings and through most ion exchange media. This leads to poor decontamination Factors (dFs) and higher radionuclide releases to the environment. A laboratory-scale testing program was conducted at Indian Point Unit No. 2 to determine the effectiveness of the use of organic polyelectrolytes to destabilize colloidal suspensions in liquid radwaste. Destabilizing colloidal suspensions will improve the removal efficiencies of the suspended material by typical filtration and ion exchange processes. The increased removal efficiencies will provide increased dFs in the liquid radwaste treatment system. The testing focused on identifying the specific organic polyelectrolytes and the associated dosages which would be effective in destabilizing the colloidal suspensions on actual waste water samples. The testing also examined the filtration characteristics of the water source to determine filter parameters such as: body feed material, body feed dosages, specific flow rates, etc., which would provide the basis for the design of filtration systems for these applications. The testing effort and the major conclusions from this investigation are given. 4 refs., 8 figs., 2 tabs.

42471 (CONF-900210–Vol.2, pp. 457-462) **Waste management evaluation for PWR full system decontamination.** Valvasori, A. (Westinghouse Electric Corp., Pittsburgh, PA (USA)); Hodges, S.; Voit, R. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A waste management evaluation has been performed for decontamination of an entire PWR primary circuit. A 5-step AP-CanDerem decontamination will generate 86 m^3 (3050 ft^3) of ion exchange resin waste. Cement solidification and resin dewatering have been used for decontamination waste disposal. The total waste processing and burial cost for solidification is at least twice as expensive as for dewatering. A combination of resin incineration, resin oxidation, and dewatering yield the most practical volume reduction.

42472 (CONF-900210–Vol.2, pp. 469-472) **Uncemented supercompacted ash - the preferential final waste form for low level radioactive waste.** Halaszovich, S. (KFA Juelich (Germany, F.R.)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Cementation of low level radioactive waste has been replaced by super compaction. Low level aqueous waste as well as combustible solid waste are turned into super compacted incinerator ash. The final waste package is a special container loaded with the pellets the voids between them backfilled with light weight concrete. This measure reduces the final volume of the waste by a factor of about 4. Consequently the costs for packaging and disposal fee are drastically reduced. Long term behavior of the product is being investigated. 3 refs., 1 tab.

42473 (CONF-900210–Vol.2, pp. 473-481) **Qualifying concrete for a low-level waste repository.** Philipose, K.E. (Chalk River Nuclear Labs., Ontario (Canada)); Feldman, R.F.; Beaudoin, J.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A waste repository for the below ground disposal of low-level radioactive waste, labelled IRUS (Intrusion Resistant Underground Structure), is planned at Chalk River Nuclear Laboratories. It relies greatly on the durability of concrete for a minimum of 500 years of service life. A research program based on laboratory testing to design a durable concrete and predict its useful engineered service

life is in progress. Durability of concrete depends on its resistance to deterioration from both internal and external causes. Since the rate of degradation depends to a major extent on the rate of ingress of aggressive ions into concrete, laboratory testing is in progress to establish the diffusion rates of ions, especially chlorides, sulfate and carbonate ions. A total of 1000 concrete specimens and 500 paste specimens are being exposed at 22° and 45°C to twenty-five different combinations of corrosive agents, including CO_2. Procedures to measure the ionic profile and to determine the factors controlling diffusion of ions in the various concretes have been developed. The paper presents the initial results from the research program and the longevity predictions to qualify concretes for the IRUS waste repository, based on twelve months of diffusion testing on laboratory specimens. 5 refs., 4 figs., 5 tabs.

42474 (CONF-900210–Vol.2, pp. 489-496) **Demonstration experience with an abrasive blasting technique for decontaminating concrete pads.** Devgun, J.S. (Argonne National Lab., IL (USA)); Land, R.R.; Doane, R.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A demonstration was performed for decontaminating a radioactively contaminated concrete pad with a portable abrasive blasting system. The system utilizes a rotating blast wheel that scours the concrete surface with metal abrasive. The metal abrasive, pulverized concrete dust, and contaminants rebound into a separator chamber. The reusable metal abrasive is recycled and the pulverized media are removed to an integral dust collection system. The exhaust is HEPA filtered to minimize release of airborne contaminants. The system was set up to remove 1.6 mm of concrete layer per pass. Decontamination factor of about 0.5 was achieved with the first pass; two subsequent passes achieved decontamination factors of 0.3 and 0.2, respectively. However, the technique had limited success in reducing contamination around the cracks and seams in the concrete where the higher activity levels of contamination were detected during the radiological survey before the cleanup. The technique can be successful and cost-effective in decontaminating large areas of low contamination; however, careful characterization and planning are necessary. 3 refs., 3 figs., 1 tab.

42475 (CONF-900210–Vol.2, pp. 497-502) **Environmental protection considerations during decommissioning.** Sheil, A.E. (British Nuclear Fuels plc, Sellafield (England)); Colquhoun, A.P. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The BNFL Sellafield site has been involved with the UK nuclear program since its inception. Consequently, the company is now faced with a major decommissioning challenge which is being met by a rolling 10-Year Program of decommissioning. The site has industrial scale plants reflecting the whole nuclear cycle from reactors through reprocessing to fuel manufacture with all associated waste facilities, etc. BNFL is committed to decommissioning of all of these facilities within a fixed period from cessation of operations. The paper reviews this program, outlines project organization and management and discusses the constraints imposed by the UK waste disposal situation. Decommissioning involves decontamination, dismantling and demolition all of which generate mobile radioactive material with potential to escape to the environment. Liquid and aerial effluents and solid residues all require attention to be paid to containment and environmental protection. BNFL's basic principle in these operations is to contain activity and immobilize it as close to the source as practical. The application of this concept is illustrated by examples from two very different projects, respectively a Mixed Oxide Fuel Fabrication Plant and the 400 ft. high Windscale Pile Chimneys. 3 refs.

42476 (CONF-900210–Vol.2, pp. 463-468) **Pilot-plant evaluation of the mobile wet oxidation process.** Finger, S.M.; Sutter, H.G.; Atwood, A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Wet Oxidation Process was originally developed and patented by JGC Corporation Japan. Pilot-plant studies of the Wet Oxidation Process were conducted. This process oxidizes chelating agents in wastewaters generated during nuclear reactor cleaning operations. Test runs were made with solutions containing NTA/EDA, EDA, and EDTA. Key findings are summarized in Table I. Based on JGC's performance data these studies were conducted to establish processability in treating wastewaters and to confirm the applicability of this process to Maine Yankee Waste. 9 figs., 6 tabs.

42477 (CONF-900210–Vol.2, pp. 483-488) **Performance of a radioactive waste interment site.** Bernhardt, D.E. (Rogers and Associates Engineering Co., Salt Lake City, UT (USA)); Owen, D.H.; Mishub, R.J.; Prewett, S.V.; Cole, L.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Aerojet disposed of 30,000 cubic meters of uranium and thorium wastes in an engineered 12,000 square meter (3 acre) interment site in Tennessee. The operation, performed under a State of Tennessee source material license, is based on termination of the license with the material remaining in place, and the option of future commercial use of the site. The closure plan included a long-term monitoring program. Yearly monitoring of the site has verified performance within the design criteria. Full-time construction monitored by a licensed engineer and extensive testing of materials ensured construction of the site according to or better than the specifications. Surface subsidence of the site has averaged about 2.2 cm with a range of 0 to 4.3 cm at 11 settlement markers after 4 years. The anticipated settlement, based on design parameters, was between 15 and 25 cm. The present anticipated settlement is 8 to 15 cm, based on the as-built parameters, and the long-term monitoring results. Slope stability analysis indicates the stability has improved with time due to consolidation of materials and reduced groundwater activity as a result of site construction. There has been no need for corrective action maintenance due to erosion, sluffing of slopes, or subsidence. Groundwater monitoring indicates the materials have been isolated, and there have also been no indications of springs or leakage from the site. 9 refs., 2 figs., 3 tabs.

42478 (CONF-900210–Vol.2, pp. 503-508) **UMTRA GJVP commingled waste project in investigation: A case history.**

Sanders, R.D. (UNC Geotech, Grand Junction, CO (SA)); Karp, K.E.; Bennett, J.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

During the course of performing work under the Uranium Mill Tailings Remedial Action program, UNC Geotech discovered that, because of past business-related operations, certain properties included in the Grand Junction Vicinity Property Project had the potential for containing commingled waste. As a result, UNC Geotech initiated a new project, the Commingled Waste Investigation Project, to further characterize those properties determined to have a possibility of containing commingled waste. 8 refs., 3 figs., 1 tab.

42479 (CONF-900210–Vol.2, pp. 509-516) **Characterization and remediation of past-practice waste units at the Hanford Site an engineering perspective.** Carlson, R.A. (Westinghouse Hanford Co., Richland, WA (USA)); Johnson, W.L.; Lauterbach, M.J.; McCain, R.G. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Hanford Site contains 1,501 identified waste management units that are to be characterized and remediated and/or permitted over the next 30 years. These units include various types of liquid and solid waste disposal sites, underground tanks, and unplanned releases consisting of nonhazardous, hazardous, radioactive, and mixed wastes. To deal with this number of waste units, the Hanford Site has been subdivided into four aggregate areas, each of which is included on the U.S. Environmental Protection Agency's National Priorities List. The collective aggregate areas have been further subdivided into 78 operable units. A discussion of progress made to date on the first six operable units is provided in this report. 6 refs., 1 fig.

42480 (CONF-900210–Vol.2, pp. 517-526) **Design of fixed-bed ion exchange columns for wastewater treatment.** Robinson, S.M. (Oak Ridge National Lab., TN (USA)); Arnold, W.D.; Byers, C.H. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Oak Ridge National Laboratory plans to use chabazite zeolites for decontamination of process wastewater which contains ppb levels of Sr-90 and Cs-137. Treatability studies have indicated that chabazite zeolites have high selectivities and loadings for removal of trace amounts of Cs-137 and Sr-90 from wastewater containing high concentrations of calcium and magnesium. These studies also indicated that the efficiency of the zeolite system is dependent on the column design and operating conditions. Results from 20-mL, 566-L, and 3,760-L column tests indicated that the optimized design of full-scale columns could halve the generation rate of loaded zeolite. The corresponding annual waste disposal costs for loaded zeolite generated at the ORNL plant varied from $80,000 to $170,000 based on the present disposal charges of $1400/m^3 indicating that design of zeolite ion exchange systems for minimization of secondary waste is imperative. This report summarizes the results of a study to model multicomponent ion-exchange columns. 7 refs., 10 figs., 5 tabs.

42481 (CONF-900210–Vol.2, pp. 527-534) **Cementation - a solution for final disposal?.** Ganser, B.L. (NUKEM GmbH, Hanau (Germany, F.R.)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

During the past 10 years NUKEM performed intensive R&D- activities concerning the cementation of radioactive waste and the control of the resulting products. Purpose of the work was to ensure the final disposal of cemented waste forms. Many of our results were used for the safety analysis for the German projects for final disposal (KONRAD and GORLEBEN). The activities covered the following items: types of commercial available cements and additives recipes including bandwidths for liquid and solid radioactive wastes mechanical properties (curing bending/compressive strength) release of radioactive elements (e.g. Cs, Sr) in case of: - leaching with brines, simulating host rock liquids - fire (underground accident) - mechanical impact (underground accident) This presentation is giving the summarized main results of this work. 14 refs., 3 figs., 5 tabs.

42482 (CONF-900210–Vol.2, pp. 535-540) **Conceptual designs for the conditioning and packaging of exchangeable non-fuel core components for final disposal in Switzerland.** Ioli, M.N.; Pipp, J.F. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Concepts for the conditioning and packaging of non-fuel reactor core components from the Swiss Nuclear Power Plants have been developed for the Swiss National Cooperative for the Storage of Radioactive Waste (NAGRA). These wastes include control rods, flow restriction rods, burnable poison rod assemblies, part length control assemblies, and primary and secondary neutron sources. Based on waste materials and available or planned container characteristics, optimization of the internal configuration of selected containers has been performed. Large concrete waste containers about 2m x 2m x 4.5m, i.e. 20m^3, foreseen for decommissioning waste could accommodate entire BWR and PWR control rods and burnable poison rods. Existing thick walled iron containers are considered for flow restriction rods and part length control assemblies. The volume of packaged waste amounts to about 1,600m^3 from the 1,600 PWR MWe and the 1,300 BWR MWe with a plant lifetime of 40 years. 3 refs., 2 figs., 2 tabs.

42483 (CONF-900210–Vol.2, pp. 541-548) **Management of fuel waste from fuel testing programs and postirradiation examination in Sweden.** Holmer, A. (Studsvik Nuclear, Nykoeping (Sweden)); Hammar, S.; Dybeck, P. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society

of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Fuel waste has been generated since 1960 at the STUDSVIK research facility in Sweden. Fuel testing programs in the materials testing reactor, R2, and post irradiation examination in the hot-cell laboratory had produced about 2200 kg of fuel waste up to 1986. The accumulated older waste as well as the waste currently generated at STUDSVIK is now being treated and encapsulated to fit the central interim storage facility for spent fuel CLAB, and later disposal in the planned repository for long–lived waste, SFL. CLAB and SFL are essential parts of the Swedish nuclear waste management system. This paper describes the treatment and the storage technology used, and the experience after five transfer operations of fuel residues from STUDSVIK to CLAB. 2 refs., 9 figs.

42484 (CONF-900210–Vol.2, pp. 549-556) **Methodology for the cost evaluation of radioactive waste management routes.** Kowa, S. (Kraftanlagen AG Heidelberg (Germany, F.R.)); Stenersen, F.; Shamsi, T.; Thiels, G.M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

One of the significant aspects of radioactive waste management is cost. To determine plant costs for radioactive waste management routes, a method was developed by the Joint Venture Kraftanlagen Heidelberg (FRG) and Task R & S (Italy) to perform a realistic, economic cost assessment of different waste management schemes. This assessment procedure was first developed for System Studies concerning the Management and Storage of radioactive waste in the frame of the 2nd R & D program of the Commission of the European Communities (CEC) and is presently being applied in the 3rd R & D program to assess the costs of different management schemes for LWR Waste and Zircaloy hulls. 9 refs., 4 figs., 3 tabs.

42485 (CONF-900210–Vol.2, pp. 565-570) **Organic colloid transport of radionuclides at Gorleben, West Germany.** Dearlove, J.P.L. (Isotope Geoscience Section, Oxon (England)); Longworth, G.; Ivanovich, M.; Kim, J.J.; Delakowitz, B.; Zeh, P. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A study has been carried out on the Gorleben glacial sand/silt aquifer system, West Germany, to determine both the nature and actinide loading of the organic colloids present at the site and their transport characteristics. Six boreholes were sampled and two distinct ground waters were identified, an organic-rich groundwater containing humic colloids and a saline groundwater which appears to contain mainly fulvic acid. A mixed organic-rich/saline groundwater has also been identified. There is unequivocal evidence for the association of uranium and thorium isotopes with the humic colloids in the organic-rich ground waters. The values of the $^{234}U/^{238}U$ activity ratio for the colloid fraction in all the boreholes sampled are different from the corresponding values for the solution phase. Uranium isotopes in the colloid fraction are therefore not in chemical equilibrium with those in solution. Other elements strongly bound to the humic colloids in the organic-rich ground waters include lanthanides and trivalent/tetravalent metals such as Fe, Mn and Ti. Divalent alkaline earths and monovalent metals are less strongly bound. 8 refs., 2 tabs.

42486 (CONF-900210–Vol.2, pp. 571-576) **A review of some geocolloid transport studies in the Farfield relevant to radioactive waste disposal.** Longworth, G. (Harwell Lab., Oxon (England)); Ivanovich, M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The major pathway for the spread of radionuclides within the geosphere surrounding a radioactive waste repository is the groundwater. Since ground waters contain colloidal particles which can sorb radionuclides and may be mobile, it is important to assess whether the presence of colloids will significantly change the radionuclide burden carried by the groundwater. Groundwater colloids from a variety of aquifers have been characterized in terms of their physical, chemical, and actinide compositions. The partition of natural series actinides has been measured using isotope dilution alpha spectrometry, between the particulate, colloid and solution phases. When the colloids are inorganic in character the fraction of total actinide activities on the colloid phase is less than one per cent for uranium and <10% for thorium. In the case of organic colloids/complexes, however, 80-90% of the uranium or thorium load is carried by the colloid phase. In addition, measurements of daughter/parent isotopic activity ratio demonstrate that the uranium associated with the colloid phase is not in chemical equilibrium with that in the groundwater. The transport of colloids is being studied using labelled synthetic colloids in a shallow glacial sand aquifer in which a set of ordered boreholes over a scale of several meters has been established by the British Geological Survey. The stability and transport behavior of these colloids has been established in laboratory column experiments before their use in a field tracer experiment. The implications of this work for modeling radionuclide transport in the geosphere is discussed. 8 refs., 3 tabs.

42487 (CONF-900210–Vol.2, pp. 557-564) **Cosine components in water levels at Yucca Mountain.** Rice, J.; Lehman, L.; Keen, K. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Water-level records from wells at Yucca Mountain, Nevada are analyzed periodically to determine if they contain periodic (cosine) components. Water-level data from selected wells are input to an iterative numerical procedure that determines a best fitting cosine function. The available water-level data, with coverage of up to 5 years, appear to be representative of the natural water-level changes. From our analysis of 9 water-level records, it appears

that there may be periodic components (periods of 2-3 years) in the groundwater-level fluctuations at Yucca Mountain, Nevada, although some records are fit better than others by cosine functions. It also appears that the periodic behavior has a spatial distribution. Wells west of Yucca Mountain have different periods and phase shifts from wells on and east of Yucca Mountain. Interestingly, a similar spatial distribution of groundwater chemistry at Yucca Mountain is reported by Matuska (1988). This suggests a physical cause may underlie the different physical and chemical groundwater conditions. Although a variety of natural processes could cause water-level fluctuations, hydrologic processes are the most likely, because the periodicities are only a few years. A possible cause could be periodic recharge related to a periodicity in precipitation. It is interesting that Cochran et al., (1988), show a crude two-year cycle of precipitation for 1961 to 1970 in southern Nevada. Why periods and phase shifts may differ across Yucca Mountain is unknown. Different phase shifts could indicate different lag times of response to hydrologic stimuli. Difference in periods could mean that the geologic media is heterogeneous and displays heterogeneous response to a single stimulus, or that stimuli differ in certain regions, or that a hydraulic barrier separates the groundwater system into two regions having different water chemistry and recharge areas. 13 refs., 5 figs., 1 tab.

42488 (CONF-900210–Vol.2, pp. 577-586) **Control of water infiltration into near surface LLW disposal units - progress report on field experiments at a Humid Region Site, Beltsville, Maryland.** O'Donnell, E. (Nuclear Regulatory Commission, Washington, DC (USA)); Ridky, R.W.; Schulz, R.K. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Three kinds of waste disposal unit covers or barriers to water infiltration are being investigated. They are: (1) resistive layer barrier, (2) conductive layer barrier, and (3) bioengineering management. The resistive layer barrier consists of compacted earthen material (e.g. clay). The conductive layer barrier consists of a conductive layer in conjunction with a capillary break. As long as unsaturated flow conditions are maintained the conductive layer will wick water around the capillary break. Below grade layered covers such as (1) and (2) will fail if there is appreciable subsidence of the cover. Remedial action for this kind of failure will be difficult. A surface cover, called bioengineering management, is meant to overcome this problem. The bioengineering management surface barrier is easily repairable if damaged by subsidence; therefore, it could be the system of choice under active subsidence conditions. The bioengineering management procedure also has been shown to be effective in dewatering saturated trenches and could be used for remedial action efforts. After cessation of subsidence, that procedure could be replaced by a resistive layer barrier, or perhaps even better, a resistive layer barrier/conductive layer barrier system. This latter system would then give long-term effective protection against water entry to waste and without institutional care. These various concepts are being assessed in six large (70 x 45 x 10 each) lysimeters at Beltsville, Maryland. 6 refs., 21 figs.

42489 (CONF-900210–Vol.2, pp. 587-596) **Cooperative LLNL/HAZWRAP project to demonstrate field-based measurement of retardation factors: Part 1. Distribution of perchloroethylene around and within permeable zones in saturated alluvial deposits.** Rice, D.W. Jr. (Lawrence Livermore National Lab., CA (USA)); Bishop, D.J.; Rogers, L.L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

As part of a cooperatively sponsored HAZWRAP and Lawrence Livermore National Laboratory (LLNL) project to evaluate field-based methods to measure retardation factors, we investigated some aspects of the variability associated with measuring the concentrations of perchloroethylene (PCE) within the saturated unconsolidated alluvial sediments beneath LLNL. Using the depth-sampling technique developed at LLNL, we are describing the relationship of VOC spatial variability to various sediment characteristics such as geophysical log results, grain size distribution, cation exchange capacity, total organic carbon, permeability, bulk density, skeletal density, and porosity. Using this information an algorithm is being developed to calculate representative field-based partitioning coefficients (Ka) and retardation factors (R). A critical parameter used in the algorithm is the total mass of PCE present in a saturated sediment sample. The two major sources of sediment PCE concentration variability examined were those associated with (1) the analytical extraction methods and (2) the spatial changes in fine-grained materials within permeable and confining sediments. To evaluate desorption efficiency during headspace extraction (EPA Method 3810) for VOC analyses (EPA Method 8010), a bulk thermal desorption chamber (BTDC) was constructed and calibrated. The BTDC extraction provided a reference method against which generally used EPA extraction methods such as headspace were compared. Compared to untreated control surrogate sediment samples, BTDC extraction efficiencies of better than 94 percent were obtained. The results of PCE comparisons between adjacent sediment samples indicated that there was no significant difference between headspace extraction techniques and the BTDC. We used both headspace and BTDC analytical results to describe the vertical distribution of PCE in four adjacent boreholes. 14 refs., 6 figs., 2 tabs.

42490 (CONF-900210–Vol.2, pp. 597-604) **Erosion corrosion of tanks during solid waste retrieval.** Elmore, M.R. (Pacific Northwest Lab., Richland, WA (USA)); Fow, C.L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Several million gallons of radioactive liquid and solid wastes are being stored in double shell tanks (DSTs) at the Department of Energy's Hanford Site in southeastern Washington. These wastes will be retrieved and processed to create a waste form suitable for permanent disposal. Solids in some of these tanks have been settling for many years, creating sludge layers on the tank floors, and must be resuspended in the supernatant liquids before waste retrieval can begin. The waste will be retrieved from a tank using a submerged slurry pump in combination with one or more rotating slurry jet mixer pumps. The mixer pumps generate two opposing high volume, high velocity jets of tank fluid and direct the jets at the settled solids. As the pump is slowly rotated, the jets sweep out arcs of fluid that suspend and mix the settled solids with the waste fluid. There is concern that the action of the jets will accelerate corrosion on the tank floor and wall. The Pacific Northwest Laboratory is performing tests to investigate this possibility. Two nonradioactive simulated wastes [neutralized cladding removal waste (NCRW) and neutralized current acid waste (NCAW)] have been tested to date. The test results are reported here. Accelerated corrosion rates due to the action of the high-velocity slurry jets have been measured

on samples of the tank material during the tests, but they appear to be low enough to allow the planned retrieval operations to be conducted safely. 5 refs., 11 figs., 1 tab.

42491 (CONF-900210–Vol.2, pp. 621-628) **Intermediate results from the laboratory scale modeling of the Finnish reactor waste disposal system.** Olin, M. (Technical Research Centre of Finland, Espoo (Finland)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In Finland the reactor waste from four nuclear power plants will be disposed of in two repositories to be built in the granite bedrock at the two power plant sites. The aim of this work is to model experimentally the inner structures and materials of two reactor waste repositories. The experimental modeling of the multi barrier system is conducted on laboratory scale by using the same principal materials as are employed in the Finnish reactor waste disposal concepts. Migration of radionuclides is then studied in two or more consecutive layers of these materials. The laboratory arrangements include the following test materials: bituminized resin and cemented ion-exchange resin, concrete, crushed rock, and water corresponding to the materials in the planned disposal systems. Cs-137, Co-60, Sr-85, and Sr-90 are used as tracers, with which the ion-exchange resin, water or crushed rock is labeled depending on the specimen type. Three to nine activity profiles have been determined for each cylindrical gamma-active sample. So far clear diffusion is observed in the profiles for cesium and strontium in crushed rock. Diffusion of Cs-137 in concrete and Co-60 in crushed rock is evident, but not so clear. Some activity profiles have been measured for beta active Sr-90 doped samples, after splitting them. Also two beta-active cubic samples have been splitted and measured. 9 refs., 9 figs., 1 tab.

42492 (CONF-900210–Vol.2, pp. 629-634) **Cost estimation of the decommissioning of nuclear fuel cycle plants: Application to reprocessing plants.** Barbe, A.; Pech, R. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Most studies conducted to date on the cost of decommissioning nuclear facilities pertain to reactors. Few such studies have been performed on the cost of decommissioning nuclear fuel cycle plants, particularly spent fuel reprocessing plants. Present operators of these plants nevertheless need to assess the magnitude of such costs, at least in order to include the related expenses in their short-, medium- or long-term projections. They also need to determine now, for example, suitable production costs that the plant owners will have to propose to their customers. Unlike nuclear reactors for which a series effect is involved (PWRs, BWRs, etc.) and where radioactivity is relatively concentrated, industrial-scale reprocessing plants are large, complex installations for which decommissioning is a long and costly operation that requires a special approach. Faced with this problem, Cogema, the owner and operator of the La Hague and Marcoule reprocessing plants in France, called on SGN to assess the total decommissioning costs for its plants. This assessment led to development by SGN engineers of a novel methodology and a computerized calculation model described below. The resulting methodology and model are applicable to other complex nuclear facilities besides reprocessing plants. 5 tabs.

42493 (CONF-900210–Vol.2, pp. 635-642) **High-impact concrete for fill in US Department of Transportation type shipping containers.** Greenhalgh, W.O.; Cash, R.J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This report describes the use of light-weight, high-impact concrete in U.S. Department of Transportation-type shipments. The formulations described are substantially lighter in weight (20 to 50 percent) than construction concrete, but product test specimens generally yield superior impact characteristics. The use of this specialty concrete for container fill, encapsulations, or liquid-waste solidification can be advantageous. Use of the material for container or cask construction has the advantage of lighter weight for easier handling, and the container consistently exhibits better performance on drop tests. High-impact concrete does have the disadvantage of less gamma radiation shielding per volume, but some formulation changes discussed in this report can be used to prepare better shielding concrete. Test characteristics of high-impact concrete are included. 3 refs., 6 figs., 7 tabs.

42494 (CONF-900210–Vol.2, pp. 651-658) **Analyses of high level radioactive glasses and sludges at the Savannah River Site.** Coleman, C.J. (Savannah River Lab., Aiken (USA)); Bibler, N.E.; Dewberry, R.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Reliable analyses of high level radioactive glass and sludge are necessary for successful operation of the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS). This facility will convert the radioactive waste sludges at SRS into durable borosilicate glasses for final disposal in a geologic repository. Analyses that are crucial to DWPF operation and repository acceptance of the glass are measurement of the radioactive and nonradioactive composition of the waste sludges and final glasses and measurement of the Fe(II)/Fe(!II) ratio in a vitrified sample of melter feed. These measurements are based on the remote dissolutions of the glass and sludge followed by appropriate chemical analyses. Glasses are dissolved by a peroxide fusion method and a method using HF, HNO_3, H_3BO_3, and HCl acids where the solutions are heated in a microwave oven. The resulting solutions are analyzed by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) and atomic absorption spectroscopy (AAS) for nonradioactive elements and appropriate counting techniques for radioactive elements. Results of replicate samples of a standard simulated nuclear waste glass indicate a precision of 5% or better for the major components. The results agree well with the standard values indicating good accuracy. Results for two radioactive glasses containing actual radioactive waste are also presented. Sludges are dissolved by the Na_2O_2 fusion method and an aqua regia method. Analyses of replicate sludge samples indicate that the results have a precision of nominally 5% or better for the major

components. Standard sludges are not available to test the accuracy of the methods; however, results of the standard glass analyzed concurrently indicate that the analyses are accurate. The two methods for the sludge are in excellent agreement indicating that they are reliable and accurate. 8 refs., 4 tabs.

42495 (CONF-900210--Vol.2, pp. 659-664) **BNFL wet spent fuel handling experience.** Coulthart, D.R.; Emmison, J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Since 1973, BNFL has handled and shipped 2,400 tons of spent LWR fuel utilizing the wet principle. This principle involves the use of customized sealed stainless steel vessels known as multi-element bottles (MEB's) and provides a convenient and safe method of shipping and transferring spent fuel. Significant benefits result, including a reduced overall operator dose uptake and a much reduced contamination of Receipt and Storage pools.

42496 (CONF-900210--Vol.2, pp. 665-674) **Integrated spent fuel storage and transportation system using NUHOMS.** Lehnert, R. (Pacific Nuclear Fuel Services, Inc., San Jose, CA (USA)); McConaghy, W.; Rosa, J. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

As utilities with nuclear power plants face increasing near term spent fuel store needs, various systems for dry storage such as the NUTECH Horizontal Modular Storage (NUHOMS) system are being implemented to augment existing spent fuel pool storage capacities. These decisions are based on a number of generic and utility specific considerations including both short term and long term economics. Since the US Department of Energy (DOE) is tasked by the Nuclear Waste Policy Act with the future responsibility of transporting spent fuel from commercial nuclear power plants to a Monitored Retrievable Storage (MRS) facility anchor a permanent geologic repository, the interfaces between the utilities at-reactor dry storage system and the DOE's away-from-reactor transportation system become important. This paper presents a study of the interfaces between the current at-reactor NUHOMS system and the future away-from-reactor DOE transportation system being developed under the Office of Civilian Radioactive Waste Management (OCRWM) program. 7 refs., 9 figs., 1 tab.

42497 (CONF-900210--Vol.2, pp. 675-680) **A cold demonstration of fuel consolidation part II - the integrated test.** Matheson, J.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

A cold demonstration test of equipment design to consolidate spent fuel assemblies was recently completed. The equipment consisted of two independent automated machines - one for consolidating the fuel assemblies, the other for shearing the remaining cages. All of the design objectives of both machines were achieved. Specifically demonstrated were (1) 2:1 consolidation of fuel assemblies, (2) 10:1 compaction of skeletons, (3) feasibility of three person operating crew, (4) ability to create one space per shift, and (5) the capability for both machines to operate in an automated mode. 7 figs.

42498 (CONF-900210--Vol.2, pp. 681-684) **The AVR high-temperature reactor - operating experience, storage and final disposal of spent fuel elements.** Theenhaus, R.; Storch, S. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The AVR is the first power plant with helium-cooled HTR to use spherical fuel elements. The experimental reactor was in successful operation for 21 years. In the first years of operation the main aim was the demonstration of the technical feasibility of high-temperature reactors. Special importance was attached to the testing and behavior of the fuel elements. The AVR was decommissioned in late 1988 and approve 170,000 spent fuel elements of various designs and compositions have been discharged. HTR fuel element reprocessing is not economically viable. Final disposal of the fuel elements is therefore envisaged after several years of intermediate storage. 3 refs., 1 tab.

42499 (CONF-900210--Vol.2, pp. 685-692) **Results of the system analysis dual-purpose repository.** Papp, R. (Kernforschungszentrum Karlsruhe (Germany, F.R.)); Closs, K.D.; Bechthold, W.; Knapp, U.; Engelmann, H.J.; Hartje, B.; Schrimpf, C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Gorleben salt dome in northern Germany is being explored so that its suitability to host a mined repository for heat-generating waste can be determined by the beginning of next century. While the disposal concept considered since the beginning of repository planning has been dealing only with reprocessing waste and 300-m-deep boreholes, current studies include both reprocessing waste and spent fuel with 300-m-boreholes as well as horizontal drifts as the basic components of the emplacement concepts. A substantial number of disposal concepts including above-ground waste treatment and cask alternatives have been designed and evaluated by means of a host of selection criteria belonging to seven different criteria fields. By this evaluation it is not only recommended to further pursue the joint borehole and drift concept (BD1) as well as drift concepts that include advanced ILW treatment but it is also identified which areas require additional R&D. 2 refs., 6 figs., 4 tabs.

42500 (CONF-900210--Vol.2, pp. 693-698) **Transportation and storage optimization of spent nuclear fuel in the United States.** Gupta, S.; Boryczka, M.K.; Collyer, P.L. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of

Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In 1987, the U.S. Congress amended the Nuclear Waste Policy Act, establishing an independent body known as the Monitored Retrievable Storage Review Commission. The mandate of the Commission was to review DOE's assessment of the advantages and disadvantages of the Monitored Retrievable Storage (MRS) facility and to evaluate the need for an MRS. The MRS Review Commission asked ICF Technology Incorporated to develop a systems integration and transportation analysis model that would aid their evaluation for Congress. The resulting model (Model for Analysis of System Risk And Cost - MARC) was adapted from an earlier model (TRICAM) written for the DOE. MARC was made available to the Commission to calculate the costs and risks (both radiological and non-radiological) of alternative spent fuel storage configurations within the Federal Waste Management System. Two of the over 30 MARC scenarios run by the MRS Commission are used to demonstrate the use of MARC in evaluating alternatives in terms of system costs and risks. These two cases are initially run in a cost minimizing mode and then in a risk minimizing mode in order to compare the difference in the value of risk for each system configuration. This example demonstrates the kind of insights MARC can yield and its utility in policy-making. 4 refs., 2 figs., 2 tabs.

42501 (CONF-900210–Vol.2, pp. 605-612) **Performance of bentonite/crushed tuff seals for nuclear waste repositories.** Ouyang, Shoung; Daemen, J.J.K. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Mixtures of bentonite and crushed rock are potential sealing materials for high level nuclear waste repositories. To allow for overall repository performance assessments, evaluations of the sealing performance under diverse conditions are needed. American Colloid c/s granular bentonite and Apache Leap tuff have been mixed to prepare samples for laboratory flow testing. Bentonite weight percent and crushed tuff gradation are the major variables studied. The sealing performance assessments include high injection pressure flow tests, polyaxial flow tests, high temperature flow tests, and piping tests. The results indicate that an appropriate composition would have at least 25% bentonite by weight mixed with well-graded crushed rock. The sealing performance of bentonite/crushed rock mixtures can be enhanced by increasing the amount of bentonite to 35%. The piping damage to the sealing performance is small if the maximum hydraulic gradient does not exceed 120 and 280 for 25 and 35% bentonite content, respectively. The hydraulic gradients above which flow of bentonite takes place are deemed critical. The pressure required to generate a critical gradient probably is related to the yield stress of the bentonite in the mixture. A difference up to one or two orders of magnitude has been observed between the vertical and horizontal permeabilities. The high horizontal permeability results from the uneven bentonite distribution in the pores between the crushed rock particles due to particle segregation. Temperature seems to have no negative effects on the sealing performance within the test range from room temperature to 60. Recommendations for future research are included. 15 refs., 5 figs., 1 tab.

42502 (CONF-900210–Vol.2, pp. 613-620) **Environmental monitoring of actinide concentration in water.** Gold, R. (Metrology Control Corp., Richland, WA (USA)); Roberts, J.H.; Preston, C.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Measurement of actinide concentration in water is described using a new and novel process based on the fission track method. Elements of this process are delineated with emphasis on the environmental sampling/neutron irradiation cell and neutron irradiation procedures. The sensitivity of this new process is compared with methods based on nuclear (decay) metrology. Advantages of this novel process are discussed with specific elaboration on the high sensitivity, the small sample size and the elimination of laboratory procedures that would introduce natural uranium contamination. Although our method does not distinguish between different fissile nuclides, the advantages of our process act in consort to provide a practical cost effective means for site wide environmental surveys of actinide pollution in ground water. 13 refs., 2 figs., 1 tab.

42503 (CONF-900210–Vol.2, pp. 643-650) **Initial results of tuff borehole sealing experiments.** Philip, J. (Nuclear Regulatory Commission, Washington, DC (USA)); Daemen, J.J.K. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Laboratory and field experiments are in progress to determine the performance that can be expected of cementitious and of earthen (bentonite) seals when emplaced in welded tuff. Laboratory testing includes materials characterization testing radial permeameter testing of cementitious borehole plugs emplaced in welded tuff cylinders, flow testing of bentonite and of bentonite/crushed tuff plugs, axial strength of cementitious borehole plugs emplaced in welded tuff, and fracture grouting experiments. Experimental work is performed in Apache Leap tuff, a formation exposed in east-central Arizona. Mineralogical, chemical, hydrological and mechanical characterization shows reasonable similarity between the Apache Leap tuff and the Topopah Spring tuff, the proposed Yucca Mountain repository host formation. The main conclusion from the mechanical characterization testing is that the tested tuff, not unexpectedly, is an extremely heterogeneous rock, with highly variable properties. A second notable observation is the extremely low saturated hydraulic conductivity of intact welded tuff, notwithstanding its very high porosity. Mixtures of bentonite and crushed tuff show that samples containing 25 or 35 percent bentonite (by weight) have permeabilities of the same order of magnitude as similarly prepared and emplaced samples consisting of bentonite only. Permeability is noticeably pressure-dependent. Short-term bond strengths of cementitious seals emplaced in tuff cylinders are moderately high, in the range of 3 to 8 MPa, with considerable variability. Results indicate a marked decrease in strength with increasing plug (or borehole) diameter. A pronounced strength loss occurs at 90C, but not at 70C. 12 refs., 6 figs.

42504 (CONF-900210–Vol.2, pp. 701-704) **Performance-assessment support for the design of the Yucca Mountain**

exploratory-shaft facility. Bingham, F.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-76DP00789. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Yucca Mountain Project, part of the waste-management program of the U.S. Department of Energy, is using performance assessment in support of the design of an exploratory-shaft facility (ESF). A summary of this support offers (1) a view of performance assessment in actual practice and (2) a preview of the methods that may be useful in future support for the development of a complete repository. The support for the ESF design began with a thorough review of the requirements that the properly designed facility must meet. This review produced a list of eleven performance-assessment analyses needed for supporting the design. These analyses will support the design by providing specific numerical constraints on the design and by evaluating proposed designs to determine whether they comply with the requirements. The analyses are exercising not only the computational capabilities of the performance-assessment effort but also many of the complex interfaces and procedures required for developing a repository. The insights gained from this effort will be valuable in future support of a full repository. 2 refs.

42505 (CONF-900210–Vol.2, pp. 705-710) **Seismotectonic investigations for Yucca Mountain high-level waste repository: Rationale for defining scope.** Gupta, D.C. (Nuclear Regulatory Commission, Washington, DC (USA)); Blackford, M.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The geologic, seismic, and engineering characteristics of the Yucca Mountain site and its environs need to be investigated in sufficient scope and detail to provide reasonable assurance that they are sufficiently well understood to permit an adequate evaluation of the proposed site for the development of a high-level waste repository. The paper examines the extent of seismotectonic investigations needed for proper evaluation of the geologic setting. At the Yucca Mountain site, a thorough understanding of tectonic phenomena such as seismicity and faulting is critical to the identification of potentially disqualifying conditions. Study of the tectonic movement, stress, or co-tectonic effects that could affect the performance of the waste-handling facilities, waste package, underground openings, shaft and borehole seals, and long-term alteration of geohydrology would be necessary. In addition, the uncertainties involved in evaluating the effect of seismotectonics on the radionuclide transport mechanism need to be thoroughly investigated. 8 refs., 1 fig.

42506 (CONF-900210–Vol.2, pp. 711-716) **Approach to developing a ground-motion design basis for facilities important to safety at Yucca Mountain.** King, J.L. (Science Applications International Corp., Las Vegas, NV (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The DOE has proposed a methodology for developing a ground-motion design basis for prospective facilities at Yucca Mountain that are important to safety. The methodology utilizes a quasi-deterministic construct called the 10,000-year cumulative-slip earthquake that is designed to provide a conservative, robust, and reproducible estimate of ground motion that has a one-in-ten chance of occurring during the preclosure period. This estimate is intended to define a ground-motion level for which the seismic design would ensure minimal disruption to operations; engineering analyses to ensure safe performance in the unlikely event that the design basis is exceeded are a part of the proposed methodology. 7 refs.

42507 (CONF-900210–Vol.2, pp. 717-724) **Yucca Mountain project prototype testing.** Hughes, W.T.; Girdley, W.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The U.S. DOE is responsible for characterizing the Yucca Mountain site in Nevada to determine its suitability for development as a geologic repository to isolate high-level nuclear waste for at least 10,000 years. This unprecedented task relies in part on measurements made with relatively new methods or applications, such as dry coring and overcoring for studies to be conducted from the land surface and in an underground facility. The Yucca Mountain Project has, since 1988, implemented a program of equipment development and methods development for a broad spectrum of hydrologic, geologic, rock mechanics, and thermomechanical tests planned for use in an Exploratory Shaft during site characterization at the Yucca Mountain site. A second major program was fielded beginning in April 1989 to develop and test methods and equipment for surface drilling to obtain core samples from depth using only air as a circulating medium. The third major area of prototype testing has been during the ongoing development of the Instrumentation/Data Acquisition System (IDAS), designed to collect and monitor data from down-hole instrumentation in the unsaturated zone, and store and transmit the data to a central archiving computer. Future prototype work is planned for several programs including the application of vertical seismic profiling methods and flume design to characterizing the geology at Yucca Mountain. The major objectives of this prototype testing are to assure that planned Site Characterization testing can be carried out effectively at Yucca Mountain, both in the Exploratory Shaft Facility (ESF), and from the surface, and to avoid potential major failures or delays that could result from the need to re-design testing concepts or equipment. This paper will describe the scope of the Yucca Mountain Project prototype testing programs and summarize results to date. 3 figs.

42508 (CONF-900210–Vol.2, pp. 725-734) **Selection of geohydrologic boundaries for ground-water flow models, Yucca Mountain, Nevada.** Downey, J.S. (Geological Survey, Denver, CO (USA)); Gutentag, E.D.; Kolm, K.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public

education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The conceptual ground-water model of the southern Nevada/Death Valley, California region presented in this paper includes two aquifer systems: a shallow, intermontane, mostly unconfined aquifer composed of unconsolidated or poorly consolidated sediments and consolidated, layered volcanics, and a deep, regional multiple-layered, confined aquifer system composed of faulted and fractured carbonate and volcanic rocks. The potentiometric surfaces of both aquifer systems indicate that ground water leaks vertically from the deeper to the shallower geologic units, and that water in the shallower aquifer may not flow beyond the intermontane subbasin, whereas water in the deeper aquifer may indicate transbasinal flow to the playas in Death Valley. Most of the hydrologic boundaries of the regional aquifer systems in the Yucca Mountain region are geologically complex. Most of the existing numerical models simulating the ground-water flow system in the Yucca Mountain region are based on limited potentiometric-head data elevation and precipitation estimates, and simplified geology. These models are two-dimensional, and are not adequate. The alternative approach to estimating unknown boundary conditions for the regional ground-water flow system involves the following steps: (1) Incorporate known boundary-conditions data from the playas in Death Valley and the Ash Meadows spring line; (2) use estimated boundary data based on geological, pedological, geomorphological, botanical, and hydrological observations; (3) test these initial boundary conditions with three-dimensional models, both steady-state and transient; (4) back-calculate the boundary conditions for the northern, northwestern, northeastern and eastern flux boundaries; (5) compare these calculated values with known data during model calibration steps; and (6) adjust the model. 9 refs., 6 figs.

42509 (CONF-900210–Vol.2, pp. 737-746) **Technical and project highlights of the defense waste processing facility.** Dillman, E.C. (Savannah River Site, Aiken, SC (USA)); Elder, H.H.; Nichols, D.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Savannah River Site has been operating a nuclear fuel cycle since the early 1950s. Fuel and target elements are fabricated and irradiated to produce nuclear materials. After removal from the reactors, the fuel elements are processed to extract the products, and the waste is stored in underground tanks. During over thirty-five years of operation, approximately 83 million gallons of high level radioactive waste have been generated. This waste has been reduced to approximately 34 million gallons by evaporation in the waste tank farms. The Defense Waste Processing Facility (DWPF) will process this waste into a borosilicate glass for long-term geologic disposal. The last major construction milestone for the DWPF was reached November 30, 1989. This paper will describe the operation of the Defense Waste Processing Facility and the status of the project including the checkout and run-in of equipment and the implementation of the Startup Test Program for nonradioactive operation. 15 refs., 10 figs.

42510 (CONF-900210–Vol.2, pp. 747-752) **Testing a new cesium-specific ion exchange resin for decontamination of alkaline high-activity waste (U).** Bibler, J.P. (Savannah River Lab., Aiken, SC (USA)); Wallace, R.M.; Bray, L.A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Radioactive Cs-137 is a fission product found in wastes produced by reprocessing fuels from nuclear reactors. The highest concentrations of this isotope in wastes from the reprocessing of defense production reactors are found in the alkaline high-activity waste, a mixture primarily of sodium nitrate and sodium hydroxide called the supernate. In recent years, much research has been directed at methods for the selective removal and concentration of Cs-137 during waste processing. The approach to the ultimate management of high-activity waste at the Savannah River Site (SRS) is to remove cesium from the supernate, combine it with insoluble sludge formed on neutralization of acidic waste, and convert them both to glass by vitrification in a joule heater melter. A cesium-specific ion exchange resin that will adequately decontaminate the supernate but will not introduce excessive amounts of organic material into the melter has been developed at SRS. The resin has been tested with simulated, both at SRS and at Battelle's Pacific Northwest Lab, and with actual supernate at SRS. It has consistently shown reliable performance and higher selectivity than other organic ion exchangers for cesium ion in those solutions. Repeated cycles on 200 mL columns using simulated supernate feed and formic acid eluent have established operation parameters for the resin. 2 refs., 3 figs., 6 tabs.

42511 (CONF-900210–Vol.2, pp. 753-758) **Double-shell tank waste pretreatment.** Orme, R.M.; Appel, J.N. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Double-shell tanks contain most of the transuranic/high-level chemical processing waste generated at the Hanford Site in recent years. A small mass fraction of this waste is responsible for its characterization as transuranic/high-level waste. Pretreatment will partition the waste into a small fraction containing most of the transuranic/high-Level components and a large fraction that is a low-level waste. The operations for achieving this objective include dissolution of water-soluble salts, dissolution of precipitated metal oxides in acid, clarification of the resulting dissolver liquors, transuranium element removal by solvent extraction and cesium removal by ion exchange. The primary benefit of pretreatment is a reduction in the overall cost of waste disposal. 3 refs., 5 figs., 2 tabs.

42512 (CONF-900210–Vol.2, pp. 759-764) **Hanford waste vitrification plant process description, process advancements, and Hanford site interfaces.** Shah, K.R. (Westinghouse Hanford Co., Richland, WA (USA)); Stegen, G.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology:*

Proceedings. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Westinghouse Hanford Company, a prime operating contractor to the U.S. Department of Energy in Richland, Washington, has the lead responsibility for development, design, construction, and operation of the Hanford Waste Vitrification Plant. The Hanford Waste Vitrification Plant will be built for the U.S. Department of Energy to vitrify existing and future liquid high level and transuranic wastes produced by defense activities at the Hanford Site. Start of construction is scheduled for mid1991. Hot startup currently is scheduled for December 1999, and acceleration of the hot startup schedule is under consideration. Requirements related to interfaces with existing Hanford Site facilities and other site specific requirements are discussed in this paper. Design of the feed transfer and lag storage, radioactive liquid waste treatment and recycle, and process off gas treatment systems is significantly affected by site specific requirements. Recent developments in design of these systems are described. 3 figs.

42513 (CONF-900210–Vol.2, pp. 765-770) **Monitored retrievable storage at Sellafield.** Wilson, G.K. (British Nuclear Fuels, Risley, Warrington (England)); Elsden, A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper describes the Monitored retrievable storage facilities constructed by BNFL at its Sellafield site.The paper first describes the different waste streams handled by BNFL and the overall routing of these waste streams. The criteria which affect store design are discussed. The paper then goes on to describe each store together with the waste characteristics which have shaped the design. Stores ranging from highly active vitrified waste stores and intermediate level waste stores to drum stores for plutonium contaminated material are described.

42514 (CONF-900210–Vol.2, pp. 771-778) **Advanced Joule-heated nuclear waste glass melters.** Tobie, W. (Karlsruhe Nuclear Research Center (Germany, F.R.)); Weisenburger, S. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper outlines the efforts made at INE to achieve substantial design improvements for a liquid-fed ceramic waste glass melter. Key points of melter improvements are given in comparison with the melter technology presently applied in the PAMELA plant at Mol/Belgium. Attention is drawn to design features which can extend melter lifetime, assure the noble metals-compatibility, and simplify the melter system. The advanced technology will be tested in a new mock-up facility presently under construction. The simulate to be used for the test campaigns corresponds to the composition of the high-level waste stored at the Karlsruhe Reprocessing Plant WAK. 8 refs., 9 figs., 1 tab.

42515 (CONF-900210–Vol.2, pp. 787-791) **Aspiration requirements for the transportation of retrievably stored waste n the TRUPACT-II package.** Djordjevic, S. (International Technology Corp., Albuquerque, NM (USA)); Drez, P.; Murthy, D.; Temus, C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-86AL31950. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Transuranic Package Transporter-II (TRUPACT-II) is the shipping package to be used for the transportation of contact-handled transuranic (CH TRU) waste between the various U.S. Department of Energy (DOE) sites, and to the Waste Isolation Pilot Plant (WIPP) located near Carlsbad, New Mexico. Waste (payload) containers to be transported in the TRUPACT-II package are required to be vented prior to being shipped (2). Venting refers to the installation of one or more carbon composite filters in the lid of the container, and the puncturing of a rigid liner (if present). This is a transportation requirement for a payload in TRUPACT-II package (2). Stored payload containers need to be aspirated for a sufficient period of time, so that under theoretical worst-case conditions, acceptably low gas concentrations are achieved. The period of time for which a payload container needs to be in a vented condition before qualifying for transport in a TRUPACT-II package is defined as the aspiration time. This paper presents the basis for evaluating the minimum aspiration time for a payload container that has been in unvented storage. Three different options available to the DOE sites for meeting the aspiration requirements are described in this paper. 4 refs., 2 figs.

42516 (CONF-900210–Vol.2, pp. 797-806) **Plutonium inventory measurements during decommissioning operations.** Buck, S. (British Nuclear Fuels plc, Sellafield (England)); Ronaldson, J.P.; Colquhoun, A. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Sellafield plant of British Nuclear Fuels plc has handled radioactive materials for over 40 years and plutonium since the early 1950s. As part of the overall decommissioning program for the site BNFL has recently undertaken the dismantling of a mixed oxide fuel manufacturing plant which has yielded valuable information in terms of project management, manpower requirements and radiation uptake. The project was deliberately chosen as a test bed for the development of decommissioning equipment and particularly methods of locating and measuring plutonium residues before and during dismantling using in situ assay techniques. Prototype equipment has now been used over a two year period for items ranging from glove boxes of $10M^3$ volume down to geometrically safe storage tanks made from 100mm pipe, and has proven invaluable. This review of experience highlights scope for improvements in the equipment and additionally considers means of applying in situ Plutonium assay in locations having access constraints or more complex chemical or plutonium isotopic compositions than was the case in this initial application. 4 refs., 2 figs., 1 tab.

42517 (CONF-900210–Vol.2, pp. 781-786) **TRU waste certification and TRUPACT-II payload verification.** Hunter, E.K. (Dept. of Energy, Carlsbad, NM (USA)); Johnson, J.E. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90:

working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The Waste Isolation Pilot Plant (WIPP) established a policy (subsequently confirmed and required by DOE Order 5820.2A, Radioactive Waste Management, September 1988) that requires each waste shipper to verify that all waste shipments meet the requirements of the Waste Acceptance Criteria (WAC) prior to being shipped. This verification provides assurance that transuranic (TRU) wastes meet the criteria while still retained in a facility where discrepancies can be immediately corrected. In this manner, problems that would arise if WAC violations were discovered at the receiver, where corrective facilities are not available, are avoided. Each Department of Energy (DOE) TRU waste facility planning to ship waste to the Waste Isolation Pilot Plant (WIPP) is required to develop and implement a specific program including Quality Assurance (QA) provisions to verify that waste is in full compliance with WIPP's WAC. This program is audited by a composite DOE and contractor audit team prior to granting the facility permission to certify waste. During interaction with the Nuclear Regulatory Commission (NRC) on payload verification for shipping in TRUPACT-II, a similar system was established by DOE. The TRUPACT-II Safety Analysis Report (SAR) contains the technical requirements and physical and chemical limits that payloads must meet (like the WAC). All shippers must plan and implement a payload control program including independent QA provisions. A similar composite audit team will conduct preshipment audits, frequent subsequent audits, and operations inspections to verify that all TRU waste shipments in TRUPACT-II meet the requirements of the Certificate of Compliance (C of C) issued by the NRC which invokes the SAR requirements. 1 fig.

42518 (CONF-900210--Vol.2, pp. 791-796) **A system to control contamination during retrieval of buried TRU waste.** Loomis, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)); Menkhaus, D.E.; Scott, D.W. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper discusses design features of a contamination control system for use during retrieval of buried transuranic (TRU) waste at the Idaho National Engineering Laboratory (INEL). Between 1952 and 1970 over 56,000m^3 of primarily Rocky Mats Plant (RFP) generated TRU waste was stored at the INEL in shallow land filled pits and trenches, which consisted of sludges, cloth, paper, metal, wood, concrete, and asphalt contaminated with micron-sized, oxidized particles of plutonium and americium. Retrieval for final disposal is one of the options being considered for this buried waste. This contamination control system is an important subsystem of an overall retrieval system design involving containment buildings, remotely controlled excavators and transporters, separation systems, and final disposal options. The main contaminants to be controlled are plutonium and americium compounds associated with the TRU waste. The contamination control system is comprised of the Dust Suppression System (DSS) and a Rapid Monitoring System (RMS). The DSS is a grouping of subsystems including: (a) the inner building laminar flow ventilation system (b) the Lifting and Moving System (LAMS) which provides mobility for (c) the Contamination Suppression System (CSS). The RMS consists of state-of-the-art air monitors and detection systems for measuring loose contamination. To complement and guide the design effort, engineering background experimental studies were performed on the DSS and RMS. The results of these studies are summarized along with a discussion of the general design features. 6 refs., 1 fig.

42519 (CONF-900210--Vol.2, pp. 807-814) **Active neutron interrogation devices for gamma irradiating solid alpha wastes.** Dherbey, J.R. (Commissariat A l'Energie Atomique, Cadarache (France)); Bignan, G.; Deidier, L.M.; Beroud, Y. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The paper presents experimental results concerning the measurement of the fissile mass content and the determination of alpha activity in solid waste having a strong gamma emission due to fission or activation products (800 1 drums containing hulls, 100 1 drums). In order to obtain accurate measurement, the passive neutron counting is combined with active neutron interrogation: 252 Cf source with delayed neutron detection and differential die away technique using the SODERN GNTO2 neutron generator (prompt neutron detection between the 14 Mev neutron pulses). 7 refs., 5 figs., 1 tab.

42520 (CONF-900210--Vol.2, pp. 815-828) **Treatment of solid waste highly contaminated by alpha emitters: Recent developments of leaching process with continuous electrolyte regeneration.** Madic, C. (CEA, Fontenay-aux-Roses (France)); Lecomte, M.; Vigreux, B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Development of processes for leaching solid waste contaminated by alpha or alpha/beta/gamma emitters has been pursued at the Nuclear Research Center in Fontenay-aux-Roses, France with the recent active commissioning of two pilot facilities: the Elise glove box system in February 1987 and the Prolixe shielded hot cell in March 1988. The Elise facility is designed to handle alpha waste and the Prolixe facility is designed to handle alpha/beta/gamma waste. The common goal of the studies conducted in these facilities is to define the operating conditions for declassification of solid waste, i.e. to ensure that the alpha concentration of this waste will be less than 3.7 x 10^6 Bq/kg after treatment, packaging and decay prior to storage in surface repositories. The leaching process developed is mainly based on the continuous electrolytic regeneration of an aggressive agent, AgII, which can induce the dissolution of PuO_2, the most difficult compound to remove from the solid waste. This paper summarizes recent achievements in the development of this process. 11 refs., 8 figs., 6 tabs.

42521 (CONF-900210--Vol.2, pp. 839-846) **The structural integrity of high level waste containers for deep disposal.** Keer, T.J. (Ove Arup & Partners, London (England)); Martindale, N.J.; Haijtink, B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards*

a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings. Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Most countries with a nuclear power program are developing plans to dispose of high level waste in deep geological repositories. These facilities are typically in the range 500-1000m below ground. Although long term safety analyses mainly rely on the isolation function of the geological barrier, for the medium term (between 500 and 1000 years) a barrier such as a container (overpack) may play an important role. This paper addresses the mechanical/structural behavior of these structures under extreme geological pressures. The work described in the paper was conducted within the COMPAS project (Container Mechanical Performance Assessment) funded by the Commission of the European Communities and the United Kingdom Department of the Environment. The work was aimed at predicting the modes of failure and failure pressures which characterize the heavy, thick walled mild steel containers which might be considered for the disposal of vitrified waste. The work involved a considerable amount of analytical work, using 3-D non-linear finite element techniques, coupled with a large parallel program of experimental work. The experimental work consisted of a number of scale model tests in which the response of the containers was examined under external pressures as high as 120MPa. Extensive strain-gauge instrumentation was used to record the behavior of the models as they were driven to collapse. A number of comparative computer calculations were carried out by organizations from various European countries. Correlations were established between experimental and analytical data and guidelines regarding the choice of suitable software were established. The work concluded with a full 3-D simulation of the behavior of a container under long-term disposal conditions. In this analysis, non-linearities due to geological effects and material/geometry effects in the container were properly accounted for. 6 refs., 9 figs., 4 tabs.

42522 (CONF-900210–Vol.2, pp. 847-852) **Performance of borosilicate glass, Synroc and spent fuel as nuclear waste forms.** Lutze, W. (Hahn-Meitner-Institut, Berlin (Germany, F.R.)); Grambow, B.; Ewing, R.C. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Presently, there are three prominent waste forms under consideration for the disposal of high-level waste: Borosilicate glass and Synroc for high-level radioactive waste from fuel reprocessing and spent fuel as the waste form for non-reprocessed fuel. Using the present experimental data base, one may compare the performance of these three waste forms under repository relevant conditions. In low water flow regimes and at temperatures less than 100°C, the fractional release rates of all three waste forms are low, on the order of 10-7/d or less and may decrease with time. Under these conditions the three waste forms behave similarly. At elevated temperatures or in high flow regimes, the durability of borosilicate glass will be much less than that of Synroc, and thus, for certain disposal schemes (e.g., deep burial) Synroc is preferable. All predictions of the long-term behavior are based on the extrapolation of short term experimental data, we point out that appropriate and useful natural analogues are available for each of these waste forms and should be used in the performance assessment of each waste form's long-term behavior. 14 refs.

42523 (CONF-900210–Vol.2, pp. 853-860) **Design & construction innovations of the defense waste processing facility.** McKibben, J.M. (Bechtel Savannah River, Inc., Aiken, SC (USA)); Pair, C.R.; Bethmann, H.K. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Construction of the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS) is essentially complete. The facility is designed to convert high-level radioactive waste, now contained in large steel tanks as aqueous salts and sludge, into solid borosilicate glass in stainless steel canisters. All processing of the radioactive material and operations in a radioactive environment will be done remotely. The stringent requirements dictated by remote operation and new approaches to the glassification process led to the development of a number of first-of-a-kind pieces of equipment, new construction fabrication and erection techniques, and new applications of old techniques. The design features and construction methods used in the vitrification building and its equipment were to accomplish the objective of providing a state-of-the-art vitrification facility. 3 refs., 10 figs.

42524 (CONF-900210–Vol.2, pp. 861-866) **Release of powdered material from waste packages.** Berg, H.P. (Bundesamt fuer Strahlenschultz (Germany, F.R.)); Gruendler, D.; Peiffer, F.; Seehars, H.D. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Possible incidents in the operational phase of the planned German repository KONRAD for radioactive waste with negligible heat production were investigated to assess the radiological consequences. For these investigations release fractions of the radioactive materials are required. This paper deals with the determination of the release of powdered material from waste packages under mechanical stress. These determinations were based on experiments. The experimental procedure and the process parameters chosen in accordance with the conditions in the planned repository will be described. The significance of the experimental results is discussed with respect to incidents in the planned repository. 8 figs., 3 tabs.

42525 (CONF-900210–Vol.2, pp. 873-880) **Coupled fluid-flow modeling of brines flowing through deforming salt around the excavations for the Waste Isolation Pilot Plant (WIPP), in the Permian Salado Formation.** Wallace, M. (International Technology Corp., Albuquerque, NM (USA)); Pietz, J.; Case, J.; Deal, D.; Lauctes, B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Small brine weeps have been observed on the exposed surfaces of the otherwise dry repository horizon excavations at the Waste Isolation Pilot Plant (WIPP). Furthermore, it is known that creep of the surrounding salt will enhance permeabilities and porosities in the region encompassing the excavations, offering the potential for increased brine inflow. This study is part of an ongoing effort

through the Brine Sampling and Evaluation Program (BSEP) to evaluate the coupled processes of salt creep and brine inflow. The previous phase of this project involved the development of a comprehensive mathematical formulation of multiphase (brine and nitrogen), temperature-dependent flow through deforming rock. Aspects of that formulation were employed in the current implementation of a salt-creep brine-inflow simulator. The coupled processes were investigated through the integration of a finite element rock mechanics code with a finite element groundwater flow code. Preliminary analyses applied to a hypothetical circular excavation showed the development of a zone of disturbed rock having enhanced permeability and porosity. This development was accompanied by the outward propagation of an unsaturated zone. For the excavation geometry considered, the development of this unsaturated zone appears to be primarily sensitive to strain fates. 16 refs., 4 figs.

42526 (CONF-900210–Vol.2, pp. 881-892) **Geochemistry of Salado formation brines recovered from the Waste Isolation Pilot Plant (WIPP) repository.** Abitz, R. (International Technology Corp., Albuquerque, NM (USA)); Myers, J.; Drez, P.; Deal, D. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-86AL31950. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Intergranular brines recovered from the repository horizon of the Waste Isolation Pilot Plant (WIPP) have major- and trace-element compositions that reflect seawater evaporation and diagenetic processes. Brines obtained from repository drill holes are heterogeneous with respect to composition but their compositional fields are distinct from those obtained from fluid inclusions in WIPP halite. The heterogeneity of brine compositions within the drill-hole population indicates a lack of mixing and fluid homogenization within the salt at the repository level. Compositional differences between intergranular (drill hole) and intragranular (fluid inclusions) brines is attributed to isolation of the latter from diagenetic fluids that were produced from dehydration reactions involving gypsum and clay minerals. Modeling of brine-rock equilibria indicates that equilibration with evaporite minerals controls the concentrations of major elements in the brine. Drill-hole brines are in equilibrium with the observed repository minerals halite, anhydrite, magnesite, polyhalite and quartz. The equilibrium model supports the derivation of drill-hole brines from near-field fluid, rather than large-scale vertical migration of fluids from the overlying Rustler or underlying Castile Formations. 13 refs., 6 figs., 6 tabs.

42527 (CONF-900210–Vol.2, pp. 893-900) **Studies of radionuclide sorption by clays in the Culebra dolomite at the WIPP site, southeastern New Mexico.** Siegel, M.D. (Sandia National Labs., Albuquerque, NM (USA)); Leckie, J.O.; Park, S.W.; Phillips, S.L.; Sewards, T. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The ability of radionuclide-rock interactions to retard the migration of plutonium and uranium within clay-lined fractures in the Culebra Dolomite Member of the Rustler Formation is being estimated in support of the performance assessment of the Waste Isolation Pilot Plant. This paper describes progress in three coordinated studies: (1) characterization of the properties of the groundwater and minerals in the Culebra that will control radionuclide retardation; (2) development of a thermodynamic model for the adsorption of uranium onto corrensite, the mixed chlorite-smectite clay mineral found in Culebra fractures; and (3) development of a database of equilibrium constants and interaction parameters for calculations of the aqueous speciation of uranium and plutonium in Na-Cl-Ca-SO_4-CO_3 solutions which contain organic ligands such as EDTA and range in ionic strength from approximately 0.8 - 6.0 molal. 22 refs., 6 figs., 1 tab.

42528 (CONF-900210–Vol.2, pp. 829-838) **A proposed ASTM standard practice for the prediction of long-term behavior of waste package materials in a geologic repository.** Pegg, I.L. (Catholic Univ. of America, Washington, DC (USA)); Macedo, P.B.; Bates, J.K.; Peterson, C.H. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Subcommittee C26.13, Repository Waste Package Materials Testing of the American Society for Testing Materials (ASTM) has been investigating the problem of making long term predictions of the behavior of materials that will be used in a geologic repository for high-level nuclear waste. Since radionuclides in the waste forms (currently spent nuclear fuel and borosilicate glass) must be contained for thousands of years, predictions of materials behavior are needed over the same extended periods of time. Such predictions present unique problems to scientists. The ASTM provides an appropriate forum for reaching a consensus solution to this problem since nuclear waste producers and receivers, licensing agencies, and general interest scientific groups are represented. The Subcommittee is now nearing completion of a Standard Practice on this subject. The purpose of this paper is to introduce the scientific community to the proposed Standard Practice. The Standard is based on development of a model for the alteration of the material in repository service. As much as possible, the model is based on a mechanistic understanding of the alteration modes. The model is then used to predict the long-term behavior of the material. 25 refs., 2 figs.

42529 (CONF-900210–Vol.2, pp. 869-872) **Construction of a cylindrical brine test room using a tunnel boring machine.** Likar, V.F. (Westinghouse Electric Corp., Carlsbad, NM (USA)); Burrington, T.P. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This paper discusses the construction of a horizontal cylindrical brine test room at the Waste Isolation Pilot Plant (WIPP). The room was constructed in the bedded salt formation at a depth of 655 meters with a tunnel boring machine. The machine leasing technical and operational management, parameters involved, and successful completion of this effort are included. 3 figs.

42530 (CONF-900210–Vol.2, pp. 907-914) **Disposal of radioactive waste into clay layers the most natural option.** Baetsle, L.H. (Belgian Nuclear Research Establishment SCK-CEN, Mol (Belgium)); Bonne, A. American Nuclear Society (USA). Fuel

Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Among the geological formations suitable for the disposal of radioactive waste, the clay formations provide outstanding opportunities : impermeable for water, self-healing, strongly absorbing for ions, widespread in nature. The self-healing properties of large clay deposits have been demonstrated by their auto-sealing and plastic response to tectonic stress and magmatic intrusion. The discovery of fossil trees preserved after geologic periods of burial in clay is one of the most dramatic illustrations of their entombment ability. The physicochemical and hydrologic characteristics of the Boom clay are very favorable for the confinement of migrating radionuclides within the layer. Except for the extremely long half-lives (^{237}Np, ^{129}I,...) no radionuclide can escape from the clay body. The effects of heat, metal corrosion, material interaction and biochemical degradation on the natural properties of the clay layer are discussed in some detail and related to the natural properties of the clay formation which have to stay unaltered for geologic periods. The first Safety Assessment Report, established by NIRAS-ONDRAF in close collaboration with SCK-CEN, has been submitted to a multi-disciplinary task force which is to advise the Belgian Government on the suitability of the Boom clay layer below the Nuclear Research site of Mol as a potential host formation for nuclear waste coming from the electronuclear program. 13 refs., 2 figs., 1 tab.

42531 (CONF-900210–Vol.2, pp. 927-938) **Fractured Apache leap tuff: interstitial, hydraulic, pneumatic, and thermal properties.** Rasmussen, T.C. (Univ. of Arizona, Tucson (USA)); Evans, D.D. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Unsaturated fractured tuff characterization with respect to flow and transport properties presents substantial methodological and technological challenges to the scientific and engineering communities. Methods and techniques are now limited to saturated and shallow unsaturated soil media. Application of these methods and techniques to deep unsaturated fractured rock media requires that existing methods be verified, as well as the development and application of new and imaginative procedures and equipment when the existing methods are inadequate. This paper presents laboratory and field data which are used for interpreting characterization methods. Interstitial, hydraulic, pneumatic, and thermal data sets are presented over a wide range of water contents and matric suctions. 14 refs., 12 tabs.

42532 (CONF-900210–Vol.2, pp. 949-956) **Evaporites and waste disposal - criteria for long-term safety.** Knipping, B. (Institute of Mineralogy and Mineral Resources, Clausthal-Zellerfeld (Germany, F.R.)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

In the Federal Republic of Germany salt deposits have mainly been used for the subsurface storage of anthropogenic wastes. This method of disposal will probably continue to be used in the future (in addition to other rock types). The Gorleben salt stock (Lower Saxony) is currently being investigated regarding its suitability as a repository for all kinds of nuclear wastes. The basis of geoscientific conclusions on the long term safety of disposing waste in salt stocks is the quantitative interpretation of processes which have altered the composition of the salt rocks in the past. Prognoses on the future geological development of a repository system could be made based on these investigations. 11 refs., 4 figs., 1 tab.

42533 (CONF-900210–Vol.2, pp. 903-906) **Blending mining and nuclear industries at the Waste Isolation Pilot Plant.** Walls, J.R. (Westinghouse Electric Corp., Carlsbad, NM (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. DOE Contract AC04-86AL31950. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

At the Waste Isolation Pilot Plant (WIPP), traditional procedures for underground mining activities have been significantly altered in order to assure underground safety and project adherence to numerous regulatory requirements. Innovative techniques have been developed for the WIPP underground procedures, mining equipment, and operating environments. The mining emphasis at the WIPP is upon the quality of the excavating not (as in conventional mines) on the production of ore. The WIPP is a United States Department of Energy (DOE) project that is located 30 miles southeast of Carlsbad, New Mexico, where the nation's first underground engineered nuclear repository is being constructed. The WIPP site, Fig. 1, was selected because of its location amidst a 607 meter thick salt bed, which provides a remarkably stable rock formation for the permanent storage of nuclear waste. The underground facility is located 655 meters below the earth's surface, in the Salado formation, which comprises two-hundred million year old halites with minor amounts of clay and anhydrites. When completed the WIPP underground facility will consist of two components: approximately 81 square kilometers of experimental areas, and approximately 405 square kilometers of repository. The repository area consists of eight storage panels with seven rooms each. Each room will have a nominal size of 3.9 meters high, 10 meters wide and 91 meters long (Fig. 2). 3 figs.

42534 (CONF-900210–Vol.2, pp. 915-926) **Simulation of gas flow beneath Yucca Mountain, Nevada, with a model based on the freshwater head.** Amter, S. (Disposal Safety Inc., Washington, DC (USA)); Ross, B. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

Subsurface gas flow is relevant to the evaluation of the Yucca Mountain, Nevada site as a potential nuclear waste repository. The equations for this flow, formulated in terms of freshwater head, were solved by the finite-difference method using a spreadsheet

program on a microcomputer. Cases solved were for current subsurface temperatures and a repository heated by 3, 14, and 30 K. Even a modest temperature increase of 14 to 30 K substantially increases the gas flux to the surface. 19 refs., 8 figs., 3 tabs.

42535 (CONF-900210–Vol.2, pp. 939-948) **Long-term climate stability and the integrity of a South African nuclear waste site.** Posnik, S.J. (Sue Posnik and Associates, Emmarentia (South Africa)); Muller, M.J.; Levin, M. American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. 1990. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. In *Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education. Volume 2, HLW and LLW technology: Proceedings.* Source: Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

The length of time that radioisotopes buried in a radioactive waste repository could remain potentially hazardous necessitates performance assessments which take long-term environmental change into consideration. The variability of climate is a key factor in the determination of possible environments and so future scenario predictions must revolve around probabilities of climatic change. A conceptual model of present wet- and dry-spell analogues over southern Africa is extrapolated into the future, based on the knowledge of climatic fluctuations in the past. Three likely future climatic scenarios are formulated and their possible consequences on the shallow-land trench repository in Bushmanland in the north western part of South Africa are discussed. The possible removal of the trench cap by erosive processes is addressed in detail. The arid and semi-arid environment that has characterized the past, is expected to continue for the next 100,000 years. Under these conditions, the removal of the trench cap by erosive processes within the next 300 years is unlikely. 31 refs., 4 figs.

42536 (DOE/LLW–82) **Guidance on stabilization and closure of US Department of Energy mixed and low-level radioactive waste disposal facilities.** Ariss, C.W.; Keck, J.F.; Klossner, K.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 209p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90015418. Source: NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Recent developments in environmental regulations pertaining to low-level radioactive and radioactive mixed waste disposal, and new advances in engineering techniques to secure waste disposal facilities and ensure regulatory compliance have prompted the need for new guidance on stabilization and closure of DOE land disposal facilities. Regulations of the US Environmental Protection Agency (EPA), US Nuclear Regulatory Commission (NRC), and orders of the US Department of Energy (DOE) that specify disposal facility closure and post-closure requirements are presented. Technical guidance on closure strategies prepared by these agencies in connection with implementing regulations are presented and interpreted in terms of unique DOE disposal facility management objectives. A standardized method to assess the performance of disposal facilities during their operational and post-operational phases is suggested to aid in meeting disposal facility performance objectives. New emerging and innovative engineering methods to stabilize wastes and disposal sites are presented, along with information necessary to evaluate the merits of individual techniques, given facility-specific conditions. Therefore, this document is intended to provide DOE disposal facility operators with the basic tools and information resources to effectively comply with DOE Order 5820.2A, and EPA and NRC regulations. 11 refs., 32 figs., 5 tabs.

42537 (IAEA-TECDOC–550, pp. 445-453) **Safety aspects of disposal of spent nuclear fuel in Sweden.** Rydell, N. (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The KBS-3 repository design from 1983 is used as reference in a brief review of safety aspects of spent fuel disposal in Sweden. The presentation follows the customary division of a repository system in barriers and is concluded by chapters on safety criteria and safety assessment. The strategy of the design is to reduce the impact of uncertainties about detailed geosphere properties by the use of corrosion resistant copper canisters to protect the spent fuel from contact with the groundwater for a considerable length of time and by distribution of the fuel packages in the bedrock so that temperatures in the rock always are kept below 100 C. Recent data from laboratory studies of radionuclide leaching from high burn-up fuel samples indicate that the fuel matrix alone is a highly efficient barrier against release of actinides. Practical tests made in the Stripa underground research facility with seals for boreholes and shafts gave good results. Uncertainties remain about details in the contribution of the geosphere to the overall safety of the repository system. Progress has been made in development of criteria addressing specific long term aspects such as assessment of rare, but over long time periods possible, extreme events and of exposure of man to radionuclides in the distant future. Old data are used to illustrate repository safety as no recent update has been made. (author). 7 refs, 5 figs.

42538 (IAEA-TECDOC–550, pp. 455-468) **The Canadian approach to safe, permanent disposal of nuclear fuel waste.** Hancox, W.T. (Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment); Nuttall, K. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The assessment of nuclear fuel waste disposal deep in plutonic rock of the Canadian Precambrian Shield is now well advanced. A comprehensive understanding has been developed of the chemical and physical processes controlling the containment of radionuclides in used fuel. The following conclusions have been reached. Containers with outer shells of titanium or copper can be expected to isolate used fuel from contact with groundwater for at least 500 years, the period during which the hazard is greatest. Uranium oxide fuel can be expected to dissolve at a rate less than 10^{-8} per day, resulting in very low rates of radionuclide release. This is consistent with observations of uranium oxide deposits in the earth's crust. Transport of radionuclides away from the containers can be significantly delayed by placing a compacted bentonite-clay based layer between the containers and the rock mass. The granite plutons of interest consist of relatively large rock volumes of low permeability separated by relatively thin fracture zones. The low permeability volumes are sufficiently large to accommodate a vault design that will ensure radionuclides do not reach the surface in unacceptable concentrations. Our field and laboratory investigations, together with assessment of conceptual disposal vault designs, give us confidence that the combination of engineered barriers and a technically suitable plutonic rock site will meet the requirements for safe disposal of nuclear fuel wastes in Canada. (author). 16 refs, 9 figs, 1 tab.

42539 (Juel-Conf–65) **Radioactive waste disposal.** Odoj, R.; Nolten, E. (comps.). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. 262p. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.),

14-15 Jun 1988). Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The current disposal concept for radioactive waste in the FRG was discussed in the framework of this seminar. In addition to this concept for the treatment of radioactive waste also the volume of this waste is indicated. The present state of the two repositories 'Konrad' and 'Gorleben' is explained, as well as the requirements on waste packages for transportation, intermediate and ultimate storage. The final part discusses the conditioning of this radioactive waste and the control of the barrels as regards the observance of the requirements. (orig.).

42540 (Juel-Conf–65, pp. 1-9) **Disposal of radwaste arising from the operation of nuclear installations. A survey.** Merz, E. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The survey is limited to waste which accumulates in the operation of nuclear power plants and reprocessing plants and which is to be delivered to the waste collecting points of the Lands. The waste is to be ultimately stored at reasonable costs in the Konrad mine. Origin, type and quantity of radioactive waste is explained. (DG).

42541 (Juel-Conf–65, pp. 10-18) **Radioactive waste treatment.** Alter, U. (Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

For the Federal Government the safe disposal of waste from nuclear power plants constitutes the precondition for their further operation. The events in the year 1987 about the conditioning and transport of low activity waste and medium activity waste made it clear that it was necessary to intensify state control and to examine the structures in the field of waste disposal. A concept for the control of radioactive waste with negligible heat development (LAW) from nuclear installations is presented. (DG).

42542 (Juel-Conf–65, pp. 13-43) **New concept for the management of radwaste from nuclear power plants.** Ermisch, K. (Preussische Elektrizitaets-AG (Preussenelektra), Hannover (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The paper discusses the legal situation of the waste storage facilities as regards the licensing of waste mixturing and the improvement of quality control measures and the supervision of the waste streams by the operators. It is an objective to reduce clearly the transports with waste with relatively higher specific activity by application of mobile conditioning plants in the nuclear plants and to limit the remaining transports to a very large extent on waste with very low specific activity. The technical measures proposed are to be completed organizationally by central waste data recording through DWK and the establishment of a single waste disposal company on the basis of GNS, placed under the responsibility of the electric utilities. (DG).

42543 (Juel-Conf–65, pp. 44-50) **The research centers' contribution to solving waste mangement problems.** Laser, M. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Abt. Dekontamination). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

According to the Federal Government's concept, private enterprises should in principle ensure the waste disposal of nuclear power plants, and research centres should only back up the processing of the waste. Thus a mobile plant is at the disposal for the compaction of solid waste. The centres made an important contribution for the decontamination and the scrapping of removed elements. For the burning of solid waste there is only one commercial plant with a capacity of about 400 Mg/a in the FRG. The remaining amount of about 150 Mg/a could be taken over by the centres in Juelich and Karlsruhe. (DG).

42544 (Juel-Conf–65, pp. 51-73) **Radioactive waste amounts.** Brennecke, P. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The results of the waste surveys carried out until now (according to waste-producer and plant, divided into conditioned and unconditioned waste) for the years from 1984 up to 1987 show that the waste pack volume, predicted up to the year 2000 is overestimated and that the actual amount of conditioned radioactive waste will possibly be significantly less than expected. The existing and planned interim storage capacities reach beyond the expected setting into operation of the Konrad mine as a final storage for radioactive waste with negligible heat development at the end of 1993. (orig./DG).

42545 (Juel-Conf–65, pp. 74-84) **Status of the Konrad storage site.** Viehl, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

In October 1986 the planning documents had so far been completed by the Physico-Technical Institute (PTB) that the plan Konrad and its abridged version by the Lower Saxon Environment Ministry - in the framework of participation of public authorities - could be forwarded to about 80 public authorities and institutions - with the request to give first statements as to the completeness of the plan. The statements given by the public authorities NLFB, Technical Supervision Association and Superior Board of Mines as well as additional demands did not detect essential defects in the plan. A legal expert's opinion that had been ordered by the Lower Saxon Environment Ministry and has meanwhile been presented produced the result that the plan, put forward by the PTB is basically complete as regards design and therefore does not require further supplements. (orig./DG).

42546 (Juel-Conf–65, pp. 85-96) **Status of the plan approval procedure for the Konrad storage site.** Beckers, K.A. (Umweltministerium des Landes Niedersachsen, Hannover (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The structure of the official plan approval procedure under atomic energy law and the authorities and institutions in charge of KONRAD are explained. Some current subsectors, which permit a survey of the present state of the procedure, are dealt with. These sectors comprise e.g. expert opinions on site evaluation and radioecology, design specifications and final storage conditions with analyses of accident conditions, criticality safety considerations and long-time safety analyses. (DG).

42547 (Juel-Conf–65, pp. 97-106) **Status of the Gorleben storage site.** Viehl, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The PTB evaluated the results of the surface site exploration which were obtained since 1979. The findings confirm the good suitability of the salt dome for the final storage of radioactive

wastes. It is reported on the planning of the shaft design for the two shafts for underground exploration. The causes of the incidents in connection with the accident in shaft 1 are explained briefly. (DG).

42548 (Juel-Conf–65, pp. 113-118) **Interim storage of radioactive waste with negligible heat generation.** Nahrath, B. (Ministerium fuer Umwelt des Landes Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The requirements on the temporary storage of approximately 65000 waste drums with different waste forms converted into units of 200 liters, consisting of conditioned waste of the Nuclear Research Centre Karlsruhe are defined in the regulations of a licence according to section 9 of the Atomic Energy Act. Thus, the wastes have to be conditioned in such a way that, after being charged into Konrad containers, they fulfill the final storage requirements of the PTB and the transport regulations of the dangerous goods ordinance for road transport (GGVS). The containers have to be corrosion resistant and the walls of the storage buildings have to be built in such a way that it is not necessary to establish a controlled access area outside the temporary storage facilities. (DG).

42549 (Juel-Conf–65, pp. 119-146) **Requirements on waste forms for ultimate storage.** Warnecke, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)); Brennecke, P.; Wurtinger, W.; Gruendler, D. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

For the control of the observance of the final storage requirements for KONRAD by the product control, it is necessary to specify or rather quantify the requirements concerning the waste packs. By means of some examples for basic and group-specific requirements of the waste product it was explained how it is possible to convert these requirements into controlable characteristic quantities. For determining the activity of radionuclides which are difficult to measure, the determination by means of measurement of key nuclides was suggested. The characteristic quantities and limitations for the requirements concerning combustibility, stability and material purity were discussed. In conclusion, there was a quantification of the characteristic quantities for the limitation of the content of a free liquid and the limitation of the gas generation. (orig./DG).

42550 (Juel-Conf–65, pp. 147-158) **Tasks of the GNS, operation of mobile radwaste conditioning plant.** Rittscher, D. (Gesellschaft fuer Nuklearservice, Essen (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

All tasks necessary for the disposal of radioactive waste from nuclear power plants such as transportation, treatment and packing are now transferred to the enterprise GNS (Society for Nuclear Safety) with the possibility of a direct influencing control by the electric utilities. The preliminary acceptance requirements of the ultimate final storage site Konrad constitute the basis for the conditioning technology. Operating licenses according to section 3 of the Radiation Protection Ordinance were obtained for the operation of the mobile conditioning plants. The conditioning and related work is illustrated by means of a diagram. (DG).

42551 (Juel-Conf–65, pp. 159-174) **Activities of the Karlsruhe Nuclear Research Center for the disposal of radioactive, solid and liquid wastes from nuclear power plant.** Pfeifer, W. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The tasks of the decontamination plants of the Karlsruhe Nuclear Research Centre, the type of the radioactive raw wastes and the treatment and processing plants being available are presented. The radioactive waste quantities from nuclear power plants which can be additionally processed in the HDB plants are listed. In the case of the waste processing in the HDB plants, the form of the present handling of orders as well as the application of an integrated information system and of the quality assurance guarantee the observance of all requirements which are mentioned in the planned 'guidelines for the control of radioactive wastes with negligible heat development'. (orig./DG).

42552 (Juel-Conf–65, pp. 175-204) **Low-level radwaste from medical, research or technical establishments.** Himme, B. (Amersham Buchler GmbH und Co. KG, Braunschweig (Germany, F.R.)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The civil, non-nuclear use of radioactive substances takes place mainly in the field of medicine. In this connection, there is a particular interest in the turnovers and the associated waste volumes. The contribution is concerned with origin, development, transport and processing of the wastes, with possibilities of disposal and determination of the nuclide-specific activity inventory as well as with microbiological control, analyses of doses at the conventional dump, an EDP-supported documentation system, the role of public authorities and legal aspects. (DG).

42553 (Juel-Conf–65, pp. 205-211) **Control of radioactive waste disposal by way of delivery to contractors.** Schneider-Kuehnle, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Biblis (Germany, F.R.). Betriebsverwaltung). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The report is limited to the situation in the Biblis nuclear power plant. The internally conditioned waste is documented, and the activity and nuclide spectra are measured. Before the waste is handed over to a contractor the documentation of type and quantity of the waste which is to be disposed of as well as an evaluation of its activity with an equivalent relation of dose rate/activity is made. Before the waste leaves the power station area, a health physics officer of the nuclear power plant seals the waste transport containers. At the place of destination the receiver checks if the seal is still intact. The outgoing waste transport is reported to the authorities according to section 78 of the Radiation Protection Ordinance. (DG).

42554 (Juel-Conf–65, pp. 212-228) **Analysis and control of radioactive forms from interim storage.** Filss, P. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

Most of the temporarily stored radioactive waste in the FRG is at present stored in the well-known, yellow 200 l waste drums. For the final disposal they still have to be placed into another container or other vessel. Before doing so this waste has to be randomly tested on the observance of the final storage requirements by the PTB product control station which is established at the Juelich Nuclear Research Centre. In addition the Juelich Nuclear Research Centre was charged by the Land authorities with the examination of individual casks for the clearing-up of irregularities of declaration. The presented non-destructive measuring methods and results are suitable for the control of old waste, especially with respect to their final storage suitability. (orig./DG).

42555 (Juel-Conf–65, pp. 229-243) **Qualification of conditioning facilities.** Wolf, J. (Kernforschungsanlage Juelich GmbH

(Germany, F.R)). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Oct 1988. (In German). (CONF-8806489–: Seminar on radioactive waste disposal, Juelich (Germany, F.R.), 14-15 Jun 1988). In *Radioactive waste disposal.* Order Number DE90512682. Source: NTIS (US Sales Only), PC A12/MF A01.

The product control of radioactive waste packs is carried out by PKS/KFA Juelich by order of the PTB. In this connection, the control by means of qualification of the methods is preferred as a long-term solution as against random sample testing. The operation conditions for a certain combination of plant/method/type of waste are defined in such a way that the observance of the final disposal requirements is guaranteed by the observance of the operation requirements. For the product control and the qualification of methods, procedures which are summarized have been developed according to this definition. (orig./DG).

42556 (LA-UR–90-2253) **Nondestructive assay of plutonium bearing scrap and waste with the advanced segmented gamma-ray scanner.** Simmonds, S.M.; Sprinkle, J.K. Jr.; Hsue, S.-T.; Kellogg, M.P. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–49: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90015101. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Assaying plutonium-bearing scrap and waste (S&W) for plutonium content can be very difficult because of the heterogeneous nature of the items. We have characterized 25 S&W items in three distinct S&W categories to 2% or better. We used these items with fabricated calibration standards to evaluate the performance of the lump- corrected segmented gamma-ray scanner. We show that some difficult-to-measure S&W samples can be assayed with less than 10% bias, but still suggest that each category of S&W be individually evaluated for measurement bias. This paper describes the capability of the advanced segmented gamma-ray scanner (SGS) to measure a wide variety of plutonium-bearing scrap and waste. Real samples were obtained from operating facilities and subsequently carefully characterized. The samples include low-density plutonium bearing ash, high-density plutonium oxide, sand-slag crucibles (SSC), and salts generated from the molten salt extraction (MSE) process. This paper demonstrates that some of these process samples can be measured quite well with the state-of-the-art techniques on the SGS. 5 refs., 6 figs., 1 tab.

42557 (LA-UR–90-2254) **Recent experiences of scrap and waste assay using neutron coincidence counting of materials from F B-Line at the Savannah River Site.** Baker, L. (Westinghouse Savannah River Co., Aiken, SC (USA)); MacMurdo, K.; Miller, M.C.; Bosler, G.E. Los Alamos National Lab., NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–48: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90015100. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The heterogeneous nature of scrap and waste poses unique problems for quantitative measurement. This is particularly true when the sample to be measured can have significant amounts of plutonium in addition to a variety of matrix components. One approach to addressing these difficulties is to combine gamma-ray and neutron counting techniques. A system combining a segmented gamma-ray scanner and neutron coincidence counter has recently been developed for the non-destructive assay of plutonium-bearing scrap and waste. Experience gained with the neutron coincidence counter portion of the system is described. Results obtained from the measurement of scrap and waste materials containing a few grams to a few hundred grams of plutonium are given. The effects of different matrices are evaluated and the role of special diagnostics is explored. 5 refs., 13 figs., 3 tabs.

42558 (LA-UR–90-2384) **Isotopic ratios and effective power determined by gamma-ray spectroscopy vs mass spectroscopy for molten salt extraction residues.** Longmire, V.L.; Cremers, T.L.; Sedlacek, W.A.; Long, S.M.; Scarborough, A.M.; Hurd, J.R. Los Alamos National Lab., NM (USA). [1990]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–39: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014913. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Impure plutonium metal is routinely processed by molten salt extraction (MSE) to reduce the amount of americium in the metal product. Throughput at various facilities where similar processes are performed has made it essential to evaluate uncertainties and possible discrepancies in the analyses of these difficult MSE materials. In an effort to evaluate the plutonium isotopic ratios and americium concentrations obtained from gamma-ray spectral data analyzed by the computer code GRPAUT, measurements were made on ten MSE salts as received and after pulverization and blending. These results were then compared to the specific powers obtained from isotopic ratios determined by mass spectrometry on these same ten samples. Americium values ranged from a few thousand parts-per-million of total plutonium to greater than 50,000 ppM. Our results indicate a small discrepancy between specific powers as determined by GRPAUT on "as received" vs pulverized and blended MSE salts. The specific powers obtained via GRPAUT on the pulverized salts agree somewhat better with specific powers obtained from the mass spectroscopy data. This work may indicate that a small discrepancy exists in the specific powers by using GRPAUT on heterogeneous, high americium samples. 5 refs., 6 tabs.

42559 (NUREG/CR–5532) **A performance assessment methodology for low-level waste facilities.** Kozak, M.W. (Sandia National Labs., Albuquerque, NM (USA)); Chu, M.S.Y.; Mattingly, P.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Sandia National Labs., Albuquerque, NM (USA). Jul 1990. 72p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–90-0375). Source: NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

A performance assessment methodology has been developed for use by the US Nuclear Regulatory Commission in evaluating license applications for low-level waste disposal facilities. This report provides a summary of background reports on the development of the methodology and an overview of the models and codes selected for the methodology. The overview includes discussions of the philosophy and structure of the methodology and a sequential procedure for applying the methodology. Discussions are provided of models and associated assumptions that are appropriate for each phase of the methodology, the goals of each phase, data required to implement the models, significant sources of uncertainty associated with each phase, and the computer codes used to implement the appropriate models. In addition, a sample demonstration of the methodology is presented for a simple conceptual model. 64 refs., 12 figs., 15 tabs.

42560 (PTB-SE–23) **Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.** Berg, H.P.; Brennecke, P. (eds.). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. 101p. (In German). (CONF-8810519–: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

The report presents the lectures of a seminar held in the framework of a session of the working group 'waste collecting depots'. The lectures deal with pretreatment and conditioning of radioactive waste from the collecting depots and of the German Federal Armed Forces. After a survey of wastes collected the requirements on the waste packages, destined for final storage, are outlined. These requirements were drawn from the safety analyses performed for the planned repository in the Konrad mine. Moreover the computer-aided checking of the fulfillment of the requirements on the acceptable activities in the waste packages is explained. (orig.).

42561 (PTB-SE–23, pp. 7-26) **Conditioning of wastes from the collecting depots of the Lands, as done by the Karlsruhe Nuclear Research Center.** Stegmaier, W. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Hauptabteilung Dekontaminationsbetriebe). Physikalisch-Technische Bundesanstalt,

Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

The basis of processing and treatment of radioactive residue materials or untreated wastes in decontamination facilities of the Karlsruhe Nuclear Research Centre is section 9 of the Atomic Energy Law. Acceptance, pre-treatment, fabrication of waste packages, release for conditioning, temporary storage and delivery of waste containers is documented according to section 47 Radiation Protection Ordinance. For this the material accounting system KADABRA is used. (DG).

42562 (PTB-SE–23, pp. 27-33) **Radwaste conditioning in facilities of the Bundeswehr.** Wolf, D. (Wehrwissenschaftliche Dienststelle der Bundeswehr fuer ABC-Schutz, Munster (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

Wastes containig tritium from the Federal Armed Forces consist of discarded indicating instruments and dials, for the production of which tritium luminous paint was used and of β-lights. For the waste processing a conversion of T into HTO is planned. The flowsheet of the high temperature incinerator and the processing of tritium luminous paint are briefly described. (DG).

42563 (PTB-SE–23, pp. 34-41) **Type and radionuclide inventory of radwaste collected by the depots of the Lands.** Brennecke, P. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

Radioactive wastes with negligible heat generation are arising from the use of radioisotopes in universities, research laboratories, industrial and commercial plants, hospitals or physicians offices. The type of wastes and quantities are described. The operators of collecting depots of the Lands provided, for preparation of a database, the necessary information for the radiological characterization of waste containers which are intended for final storage in the Konrad repository. (DG).

42564 (PTB-SE–23, pp. 42-56) **Requirements to be met by waste forms and packages.** Berg, H.P. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)); Brennecke, P. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

The system of requirements on the waste packages that are destined for storage in the planned Konrad repository is divided into requirements on the waste form, the waste container and the inventory of radionuclides in the waste package. In addition to these requirements, also the general requirements on the waste packages are explained. For the checking of the inventories of radionuclides the ANKONA program has been developed. (DG).

42565 (PTB-SE–23, pp. 57-75) **Acceptable limits of radioactivity in waste packages delivered by the collecting depots of the Lands.** Berg, H.P. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

The acceptable activities per waste container are listed separately for diverse parts of the safety analysis und in particular the frequently occurring radionuclides in wastes from the collecting depots are discussed. To determine the activity limits for the individual radionuclides the calculations were each made with the same activity value, taking into account the thermal influence of the host rock. Some changes in the preliminary requirements for ultimate disposal are discussed. (DG).

42566 (PTB-SE–23, pp. 76-99) **The ANKONA program and its applications.** Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle. Mar 1989. (In German). (CONF-8810519--: Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States, Braunschweig (Germany, F.R.), 21 Oct 1988). In *Conditioning and final storage of radioactive wastes from collecting depots of the Federal States. Lectures.* Source: Available from Wirtschaftsverlag NW Verl. fuer neue Wissenschaft, Bremerhaven (Germany, F.R.).

The ANKONA program was developed to check the requirements on a waste form for ultimate storage derived from the analyses of specified operation, incidents, thermal influence of host rock and the nuclear criticality safety. The version 2.0 of ANKONA is based primarily on the planning data for the Konrad repository, as of October 1986. Moreover, for the safety analysis the Radiation Protection Ordinance presently in force has been used as basis. The acceptable activities from the individual parts of the safety analyses are listed in data tables which are read in at the beginning of the program run. (orig.).

42567 (RFP–4398) **High resolution seismic reflection applications in ground water monitoring design.** Lewis, B.R.; Folger, P.F.; Arndt, M.B. EG and G Rocky Flats, Inc., Golden, CO (USA). [1990]. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC34-90DP62349. (CONF-9009116--1: Spectrum '90: radioactive waste technologies, decontamination, decommissioning and hazardous wastes, Knoxville, TN (USA), 30 Sep - 4 oct 1990). Order Number DE90008862. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The bedrock underlying the Rocky Flats, Golden, Colorado is comprised of claystone, siltstone and sandstone that were deposited by a complex fluvial system. Because of the heterogeneities inherent in such a complex stratigraphic system, monitoring networks should be based on an accurate reconstruction of the depositional system. The inherent costs for such a network prompted an evaluation of alternative methods to characterize the subsurface geology. Shallow high resolution seismic reflection was modeled and field tested in light of remedial investigation objectives to assess ground water contamination. In addition, paleochannel morphologies, facies changes, and other stratigraphic and structural features not evident from borehole correlations were indicated. The current stratigraphic and depositional models are being re-evaluated to incorporate this preliminary seismic information. A conceptual three-dimensional geologic model, in addition to previously collected contaminant data, is being used to develop the monitoring networks at the Rocky Flats Plant. 6 refs., 13 figs.

42568 (UCRL–21082) **Background studies in support of a feasibility assessment on the use of copper-base materials for nuclear waste packages in a repository in tuff.** Van Konynenburg, R.A. (Lawrence Livermore National Lab., CA (USA)); Kundig, K.J.A.; Lyman, W.S.; Prager, M.; Meyers, J.R.; Servi, I.S. Lawrence Livermore National Lab., CA (USA); CDA/INCRA Joint

Advisory Group, Greenwich, CT (USA). Jun 1990. 244p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-48. Order Number DE90015107. Source: NTIS, PC A11/MF A01; OSTI; INIS; GPO Dep.

This report combines six work units performed in FY'85–86 by the Copper Development Association and the International Copper Research Association under contract with the University of California. The work includes literature surveys and state-of-the-art summaries on several considerations influencing the feasibility of the use of copper-base materials for fabricating high-level nuclear waste packages for the proposed repository in tuff rock at Yucca Mountain, Nevada. The general conclusion from this work was that copper-base materials are viable candidates for inclusion in the materials selection process for this application. 55 refs., 48 figs., 22 tabs.

42569 (UCRL–102116) **The use of performance assessments in Yucca Mountain repository waste package design activities.** Jardine, L.J. Lawrence Livermore National Lab., CA (USA). Jan 1990. 5p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-48. (CONF-900406–70: 1. international topical meeting on high-level radioactive waste management, Las Vegas, NV (USA), 8-12 Apr 1990). Order Number DE90015039. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Yucca Mountain Project is developing performance assessment approaches as part of the evaluations of the suitability of Yucca Mountain as a repository site. Lawrence Livermore National Laboratory is developing design concepts and the scientific performance assessment methodologies and techniques used for the waste package and engineered barrier system components. This paper presents an overview of the approach under development for postclosure performance assessments that will guide the conceptual design activities and assist in the site suitability evaluations. This approach includes establishing and modeling for the long time periods required by regulations: near-field environment characteristics surrounding the emplaced wastes; container materials performance responses; and waste form properties. All technical work is being done under a fully qualified quality assurance program.

42570 (WHC-EP–0182-25) **Tank farm surveillance and waste status summary report for April 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Jun 1990. 48p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. Order Number DE90015477. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for high-level radioactive waste stored in underground tanks at the Hanford Site. Data that depict the status of stored, high-level waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each on the existing 177 underground waste tanks and provide supplement information regarding tank anomalies and ongoing investigation. 1 tab.

42571 (WHC-EP–0212-1) **Hanford Site Environmental Restoration and Waste Technology Plan: Calendar year 1990.** Anantatmula, R.P. (comp.). Westinghouse Hanford Co., Richland, WA (USA). Jun 1990. 615p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. Order Number DE90015390. Source: NTIS, PC A99/MF A01 - OSTI; GPO Dep.

The Hanford Site Environmental Restoration and Waste Management Technology Plan provides a description of the technology required to implement waste disposal and inactive site cleanup as dictated by environmental requirements. The Hanford Site Environmental Restoration and Waste Management Technology Plan is composed of sections that address the technology requirements related to eight different functional and waste categories. Each category includes descriptions of related technical issues and the tasks that must be performed to resolve them. Summary projections of cost and schedule for resolution of pertinent technical issues are included within each functional or waste category and within an overall cost summary section. The document is compiled from reports authored by individuals directly involved in the planning and implementation of technology development activities related to the various technical issues. The Hanford Site Environmental Restoration and Waste Management Technology Plan is revised periodically. 67 figs., 26 tabs.

42572 A proposed concrete shaft liner design method for an underground nuclear waste repository. Richardson, A.M. (Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)); Schmidt, B.; St. John, C.M.; Stinebough, R.E. pp. 93-98 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

General requirements and performance objectives for nuclear waste repository shafts (operational safety and waste retrievability) are defined in 10 CFR 60.133. The generic requirements document interprets and expands these requirements into more specific functional requirements for liners of these shafts, including structural integrity, provisions for attaching shaft fittings, and water control. These requirements also apply to the exploratory shafts used for site characterization because they may later be used in the repository. Cast-in-place concrete liners are excellent for vertical shafts, providing security from rockfalls, convenient attachment of shaft equipment, low resistance to ventilation airflow, and protection of the wall rock from weathering. Concrete-lined shafts are planned for the proposed waste repository in Nevada. To meet repository licensing requirements, a design methodology for liners must be developed that considers the effects of induced thermal and seismic loads on the liner in the context of repository performance requirements. The major steps of a proposed methodology are outlined in this paper.

42573 Evaluation of site-generated radioactive waste treatment and disposal methods for the Yucca Mountain repository. Subramanian, C.V. (Sandia National Labs., Livermore, CA (USA)); Jardine, L.J. pp. 87-92 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This study identifies the sources of radioactive wastes that may be generated at the proposed high-level waste (HLW) repository at Yucca Mountain, NV, estimates the waste quantities and characteristics, compares technologies available for waste treatment and disposal, and develops recommended concepts for site-generated waste treatment and disposal. The scope of this study is limited to operations during the emplacement phase, in which 70,000 MTU of high-level waste will be received and emplaced at the proposed repository. The evaluations consider all radioactive wastes generated during normal operations in surface and underground facilities. Wastes generated as a result of accidents are not addressed; accidents that could result in large quantities of radioactive waste are expected to occur very infrequently and temporary, portable systems could be used for any necessary cleanup. The results of this study can be used to develop more definitive plans for managing the site-generated wastes and as a basis for the design of associated facilities at the proposed repository.

42574 An overview of the National Civilian Radioactive Waste Management Program. Stein, R. (USDOE Office of Energy Research, Washington, DC (USA)). pp. 37-44 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper presents an overview of the aspects associated with the disposal of spent nuclear fuel and high level waste. The author reviews safety, cost effectiveness, and compliance with regulatory requirements.

42575 MRS to transportation system interfaces. Row, T.H. (Nuclear and Chemical Waste Programs, Oak Ridge National Lab., Oak Ridge, TN (US)); Croff, A.G. pp. 1-16 of The integrated spent fuel and HLW management system. American Nuclear Society, La Grange Park, IL (USA) (1987). DOE Contract AC05-84OR21400. (CONF-870948–: American Nuclear Society topical meeting on the integrated spent fuel and HLW management system, Albuquerque, NM (USA), 28-30 Sep 1987).

The U.S. Department of Energy (DOE) proposes to construct and operate a facility for the monitored retrievable storage (MRS) of spent fuel at a site on the Clinch River in Oak Ridge, Tennessee. The authors provide an assessment of the technical and institutional issues regarding MRS to transportation system interfaces.

42576 A repository view of the system. Hunter, T.O. (Sandia National Labs., Albuquerque, NM (USA)). pp. 1-19 of The integrated spent fuel and HLW management system. American Nuclear Society, La Grange Park, IL (USA) (1987). (CONF-870948–: American Nuclear Society topical meeting on the integrated spent fuel and HLW management system, Albuquerque, NM (USA), 28-30 Sep 1987).

A nuclear waste repository will not receive a single, well-defined waste type from one source. Spent fuel from several different reactor types and several defense waste processing facilities will be received. The current operating design basis of 3,400 MTU, or equivalent, annual receipt rate and 70,000 MTU total disposal capacity places unique requirements on the transportation-repository interface at the repository. Waste could arrive in truck or rail casks. With a 70/30 truck/rail mix (by mass) approximately 2,300 truck and 140 rail casks would arrive annually. Further some 10,000 fuel assemblies would be processed annually by the repository surface facility and 2,000 emplacement containers of spent fuel or high-level waste would be prepared for disposal. This throughput will place a significant demand for efficient waste-handling technology and operations on the repository. If spent fuel consolidation is performed at the repository, the requirements on the surface facility will be especially demanding. If spent fuel is consolidated or prepackaged at the MRS, there will be a major impact on the specification of the transportation-repository interface.

42577 Reactor fuel management practices and utility waste system issues. Fuierer, A.A. (Rochester Gas and Electric Corp., NY (USA)). pp. 1-26 of The integrated spent fuel and HLW management system. American Nuclear Society, La Grange Park, IL (USA) (1987). (CONF-870948–: American Nuclear Society topical meeting on the integrated spent fuel and HLW management system, Albuquerque, NM (USA), 28-30 Sep 1987).

This paper discusses the integration of utility reactor spent fuel and related hardware with the DOE waste system for its ultimate disposal and system integration issues. Cost impacts are also considered.

42578 Cost benefit assessment methodology for seismic design of high level waste repository facilities. Subramanian, C.V. (Sandia National Labs., Livermore, CA (USA)); Hadjian, A.H. pp. 105-110 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper summarizes a methodology for performing a cost benefit assessment of the seismic design of the surface facilities associated with the prospective high- level waste repository at Yucca Mountain, NV. The methodology described will develop the costs and benefits of varying design levels for vibratory ground motion and surface fault displacements for structures, components, and equipment in the repository facilities.

42579 Stability of underground openings in the Yucca Mountain repository. Blejwas, T.E. (Sandia National Labs., Albuquerque, NM (USA)). pp. 153-158 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The licensing of a repository for high level radioactive waste will require assurances that underground openings do not experience frequent major instabilities, which are defined here as sudden movements of blocks of rock that limit the functions of the openings. Although the design of nuclear power plant structure is controlled by strict adherence to building or professional- engineering codes, this approach is not practical for the structural design of underground facilities because the design must accommodate a varied and partially defined geologic setting. However, regulations require the reduction of the potential for deleterious rock movement and the design of openings to maintain the option to retrieve waste. The present plans for meeting these requirements for a repository at Yucca Mountain, Nevada, include a program of state-of-the- art analyses and modified forms of existing empirically based design methods. An extensive experimental program is required to provide confidence in the results of the design- analysis process.

0530 Environmental Aspects

Refer also to citation(s) 42396, 42567, 42578, 43273

42580 Horizontal coring using air as the circulating fluid: Some prototype studies conducted in G Tunnel at the Nevada Test Site for the Yucca Mountain Project. French, A. (Reynolds Electrical and Engineering Co., Las Vegas, NV (US)). pp. 59-64 of Proceedings of the drilling technology symposium 1990: Volume 27. Weiner, P.D.; Kastor, R.L. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

This paper reports on horizontal coring using air as the circulating fluid conducted in the G Tunnel Underground Facility (GTUF) at the Nevada Test Site. This work is part of the prototype investigations of hydrogeology for the Yucca Mountain Project. The work is being conducted to develop methods and procedures that will be used at the Department of Energy's Yucca Mountain Site, a candidate site for the nation's first high-level nuclear waste repository, during the site characterization phase of the investigations.

0540 Health and Safety

Refer also to citation(s) 42400, 42406, 42571, 42574, 42775, 42780, 42807, 43617

42581 (BNL–44771) **Evaluation of health risks associated with proposed ground water standards at selected inactive uranium mill-tailings sites.** Hamilton, L.D.; Medeiros, W.H.; Meinhold, A.; Morris, S.C.; Moskowitz, P.D.; Nagy, J.; Lackey, K. Brookhaven National Lab., Upton, NY (USA). Apr 1989. 103p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-76CH00016. Order Number DE90015133. Source: NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

The US Environmental Protection Agency (EPA) has proposed ground water standards applicable to all inactive uranium mill-tailings sites. The proposed standards include maximum concentration limits (MCL) for currently regulated drinking water contaminants, as well as the addition of standards for molybdenum, uranium, nitrate, and radium-226 plus radium-228. The proposed standards define the point of compliance to be everywhere downgradient of the tailings pile, and require ground water remediation to drinking water standards if MCLs are exceeded. This document presents a preliminary description of the Phase 2 efforts. The potential risks and hazards at Gunnison, Colorado and Lakeview, Oregon were estimated to demonstrate the need for a risk assessment and the usefulness of a cost-benefit approach in setting supplemental standards and determining the need for and level of restoration at UMTRA sites. 8 refs., 12 tabs.

42582 (BNL–44772) **Health risk analysis for ingestion of contaminants from existing groundwater contamination at selected UMTRA project sites.** Hamilton, L.D.; Medeiros, W.H.; Meinhold, A.; Morris, S.C.; Moskowitz, P.D.; Nagy, J. Brookhaven

National Lab., Upton, NY (USA). Sep 1988. 84p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-76CH00016. Order Number DE90015134. Source: NTIS, PC A05/MF A01; OSTI; INIS.

This study examines potential hazards to human health from the ingestion of chemicals in ground waters beneath and adjacent to four abandoned uranium mill-tailings sites: Gunnison, Colorado; Lakeview, Oregon; Monument Valley, Arizona; and Riverton, Wyoming. Chemicals of concern in the ground water near these sites include arsenic, cadmium, chromium, lead-210, molybdenum, nitrate, polonium-210, radium 226 and radium 228, selenium, sulfate, thorium-230, uranium and vanadium. Hazards to health were evaluated by implementing the method outlined in the Environmental Protection Agency's (EPA's) Superfund Public Health Evaluation Manual. Conservative assumptions in the method, and the effect of these on the risk estimates and EPA's indices of harm are discussed. Because the method has a number of built-in conservatisms, the estimated risks and indices only indicate sites and chemicals requiring further analysis. The chemicals and sites identified as presenting risk in this first screening step should be investigated in more detail. Necessary steps are given. Sites and chemicals identified as harmless in this initial screening can be eliminated from further consideration. 9 refs., 4 figs., 4 tabs.

42583 (CEA-IPSN-RA–1988) **The 1988 progress report of the Nuclear Safety and Protection Institut.** CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire. 1988. 157p. (In French). Order Number DE90511912. Source: NTIS (US Sales Only), PC A08/MF A01.

The 1988 progress report of the Nuclear Safety and Protection Institut (CEA, France). The Institute's fields of action involve: The activities and technical safety of the nuclear power plants, the environmental and human radiation protection which includes technical, health and medical aspects, the nuclear materials compatibility and control and the accident intervention actions. The 1988 Institute activities are characterized by the continuity of the previous technical safety directives, by the improvement of the nuclear risk communication and of the international cooperation.

42584 (CONF-9007106–34) **An automatic locating and data logging system for radiological walkover surveys.** Nyquist, J.E.; Blair, M.S. Oak Ridge National Lab., TN (USA). [1990]. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Institute of nuclear materials management conference; Los Angeles, CA (USA); 15-18 Jul 1990. Order Number DE90014457. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Oak Ridge National Laboratory has developed an Ultrasonic Ranging and Data System (USRADS) to track a radiation surveyor in the field, to log his instrument's reading automatically, and to provide tabular and graphical data display in the field or in the office. Once each second, USRADS computes the position of the radiation surveyor by using the time-of-flight of an ultrasonic chirp, emitted by a transducer carried in a backpack, to stationary receivers deployed in the field. When the ultrasonic transducer is pulsed, a microprocessor in the backpack radios the start time and survey instrument's reading to the master receiver at the base station (a van or truck). A portable computer connected to the master receiver plots the surveyor's position on the display, and stores his position and instrument reading. The CHEMRAD Corporation has just completed a survey of the ORNL main plant area using two radiation survey instruments simultaneously: a ratemeter connected to a NaI crystal that is swung in a arc near the ground, to look for surface contamination; and a small pressurized ionization chamber (PIC), attached to the backpack frame at a height of 3 ft, to measure the exposure rate. 3 refs., 5 figs.

42585 (DOE/NCT–05, pp. 5-12) **Criticality alarms: How sensitive to what?.** Seale, R.L. (Univ. of Arizona, Tucson (USA)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The focus of the role of criticality alarm systems to personnel warning in the event of an accident that has the potential to threaten life is emphasized. The evaluation of radiation dose versus distance from prior accidents and through experiments conducted with the SILENE and SHEBA facilities is summarized. The influence of material properties and process design on the nature of criticality events is identified. In particular, the effect of enrichment in reactivity addition rates and the heat capacity of critical mixtures and their influence on possible critical system radiation burst shapes and duration is discussed. Finally, the diverse signatures of accident criticalities and the resulting challenges to the performance of criticality alarms is discussed.

42586 (DOE/NCT–05, pp. 13-18) **The development of criticality accident alarm system standards.** Smith, D.R. (Los Alamos National Lab., NM (USA)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

A brief summary of the historical development of criticality accident alarm system standards since the 1966 meeting of the American Nuclear Society is presented. Technological developments and improvements in standard ANS 8.3 in recent years have lead to a national standard and an international standard providing similar and compatible guidance for the installation, maintenance, and use of criticality alarm systems, and an international standard providing guidance on specification and testing characteristics of equipment to be used in such systems. Suggestions for further improving the standard, specifically, clarification of the detection criteria and evacuation procedures, are discussed.

42587 (DOE/NCT–05, pp. 19-26) **Criticality alarm system verification at the Los Alamos critical experiments facility: Past experience and present capabilities.** Plassmann, E.A. (Los Alamos National Lab., NM (USA)); Spriggs, G.D. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Los Alamos Critical Experiments Facility (LACEF) has been involved in the testing and evaluation of criticality accident alarm systems since 1980. At that time the solution critical assembly SHEBA was designed and built. The response of the alarms to neutron pulses was done using the GODIVA-IV Burst Assembly. Currently, SHEBA and a new fast assembly, SKUA, are being modified for burst operation.

42588 (DOE/NCT–05, pp. 27-34) **Self limiting features of a accidental criticality in a solution system.** Malenfant, R.E. (Los Alamos National Lab., NM (USA)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

Experience with the SHEBA solution critical assembly during validation testing of accidental criticality alarm detectors provided several insights into the character of potential accidental excursions. Two observations were of particular interest. First, it is nearly impossible to maintain a solution system, particularly one employing low-enrichment material, in a constant state. If supercritical, the system will heat up, expand (or form bubbles), return to a sub-critical state, and shut down of its own accord without going into short period oscillations. Second, a very slow change in the system could produce a long pulse resulting in lengthy exposures, a high dose, but a low dose rate. The experiments dramatically contradicted the popular contention that accidental criticality is characterized by a blue flash, a clap of thunder, and violent expulsion of material.

42589 (DOE/NCT–05, pp. 67-68) **Criticality alarm systems at the Idaho Chemical Processing Plant.** Wenzel, D.R. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Idaho Chemical Processing Plant (ICPP) has a number of criticality alarm systems (CAS) in the various facilities. The complexity of the plant creates some unique CAS problems. A detailed review of the CAS has been made to determine the level of compliance with ANSI 8.3-1986. A major CAS upgrade project is currently in the design stage which will expand coverage and bring all CAS monitoring unshielded areas into full compliance with ANSI 8.3-1986. Because DOE Orders do not contain an exclusion that exempts the need for CAS coverage in shielded areas as provided in ANSI 8.3-1986, a future CAS upgrade project is in the planning stage which will also upgrade the CAS coverage in shielded portions of the plant.

42590 (DOE/NCT–05, pp. 35-46) **The Y-12 criticality alarm system.** Handley, G.R. (Oak Ridge Y-12 Plant, TN (USA)); Smarsh, J. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Y-12 Plant has had a criticality alarm system since 1945. The alarm system as presently configured was conceived and installed in 1957. Two Nuclear Measurements Corporation (NMC) gamma-sensitive scintillation detectors (currently Model GA-6) are situated side-by-side to comprise a station. Two stations are located at least 100 feet apart providing redundant coverage for each area that requires an alarm. The radius of detection for each station is 400 feet for an alarm set point of 50 mR/hr. To assure fail-safe operation, any one of four combinations of output (0 & 0 mR/hr, 0 & 50 mR/hr, 50 & 0 mR/hr, or 50 & 50 mR/hr) from any station (two detectors) will initiate the alarm signal over the public address system. The public address system is tested each morning. Each station is triggered monthly with a small gamma source, and each detector is replaced with a recently calibrated detector every 12 months. New detectors must pass acceptance testing at a fast burst reactor prior to installation. Experience has shown a need for redundancy in the entire system including the annunciation of the alarm signal.

42591 (DOE/NCT–05, pp. 47-58) **Savannah River NIM [nuclear incident monitors] system maintenance program.** McMahan, J.W. (E. I. du Pont de Nemours & Co., Aiken, SC (USA)); Clayton, J.D.; Henderson, W.A. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Savannah River Plant (SRP) uses 260 nuclear incident monitors (NIMs) of its own design to detect and alarm nuclear criticality. The in-house maintenance program includes routine field testing, with central facility repair and calibration. A central file of malfunction and calibration data is maintained and analyzed to determine component reliability.

42592 (DOE/NCT–05, pp. 59-66) **Criticality alarm system design and operational experience at the Westinghouse Materials Company of Ohio.** Eversole, M.J. (Westinghouse Materials Co. of Ohio, Cincinnati (USA)); Lindenschmidt, D.J. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Feed Materials Production Center (FMPC) handles a wide variety of uranium materials ranging in enrichment from depleted to 19.99% U235. Due to the presence of enriched uranium materials onsite, a criticality alarm system is required. This paper describes past, present, and future criticality alarm system designs, as well as problems which have been encountered during design, installation, and operation of those systems.

42593 (DOE/NCT–05, pp. 69-78) **Experience with neutron criticality alarm systems at Westinghouse Hanford Company.** Paglieri, J.N. (Westinghouse Hanford Co., Richland, WA (USA)); Conner, R.P. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The neutron-sensitive criticality alarm system developed at the Hanford Site was installed in a number of buildings and has demonstrated satisfactory performance during approximately 20 yr of operation. Neutron detection is provided by a boron-10 trifluoride (BF_3) tube in each detector. A description of the criticality alarm system is provided and the results of testing with short duration radiation pulses are discussed. Early and long-term operating experience is addressed including resolution of operating problems, spurious alarms, and trip levels. Modification, testing, and maintenance of the system is discussed including lessons learned. The commercial neutron-sensitive criticality alarm system that was recently installed in a large facility is also described. Important aspects of installing/testing the system and operating experience are discussed.

42594 (DOE/NCT–05, pp. 79-102) **Criticality alarm system for the Lawrence Livermore National Laboratory.** Hill, E.E. (Lawrence Livermore National Lab., CA (USA)); Kolar, O.C. Lawrence Livermore National Lab., CA (USA). 1988. DOE Contract W-7405-ENG-48. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The Lawrence Livermore National Laboratory (LLNL) has specified a standard criticality alarm system (CAS) for use in all its nuclear facilities. This report describes the initial CAS as supplied from the vendor and the modifications made to develop a generic system that better suits LLNL needs. Each such system contains gamma detectors, data-acquisition modules (serviced by uninterruptable power supplies), one or more control terminals, and an emergency evacuation alarm module (also with an uninterruptable power supply). Although the primary function of the CAS is to sound an alarm in the event of a criticality accident, the system can also be used to collect dosimetry data for assessing background radiation levels, to monitor possible secondary criticalities in the event of an accident, and to monitor post-accident conditions remotely. Steps have been taken to assure that these additional functions do not compromise the primary alarm function. The present status of the new standard system, our experience with it, and future plans for other CAS components are also described in this report.

42595 (DOE/NCT–05, pp. 103-110) **The EDAC [Ensemble de Detection et d'Alarmes de Criticite] system and new developments under consideration at the Commissariat a l'Energie Atomique for criticality accident detection.** Barbry, F. (Commissariat a l'Energie Atomique, Is-sur-Tille (France)); Prigent, R. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

As a result of the Commissariat a l'Energie Atomique CRAC experimental program, which studied the phenomenology and the radiological consequences of a criticality excursion in fissile solution, the EDAC [Ensemble de Detection et d Alarms de Criticite] system has been developed. This system detects a criticality accident and warns personnel as early as possible by triggering the necessary audo-visual alarm. The main features of this equipment are its ability to cover all types of accidental kinetics and to use sensors giving a total dose response in neutron and gamma radiation. According to new results acquired with the SILENE reactor in the field of criticality accidents, an evolution is taking place in France. An improved EDAC system is being designed not only to trigger a criticality alarm but also to provide information on the accident, to assist in accident diagnosis, and to contribute to being better equipped to cope with an accident situation, for example, intervention is needed or if reoccupation of evacuated areas is desired.

42596 (DOE/NCT–05, pp. 111-124) **Design criteria and the principles underlying the UKAEA code of practice on the provision of criticality alarm systems.** Delafield, H.J. (Harwell Lab., Oxon (England)). Lawrence Livermore National Lab., CA (USA).

1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

Design principles and criteria for criticality detection and alarm systems are given based on the requirement to detect different types of criticality excursion and the need to take account of the developments in radiation detectors. The characteristics of a criticality incident are described in terms of the minimum incident of concern (10^{15} fissions occurring in a duration between 1 ms and 1 minute) and the radiation field. Criteria for the threshold of detection are derived for integrating and rate-of-change systems employing gamma-ray or neutron detectors. General guidance is given on the principles to apply in the selection and siting of criticality detectors.

42597 (DOE/NCT–05, pp. 125-132) **Transportable criticality alarm system.** Clem, W.E. (Westinghouse Hanford Co., Richland, WA (USA)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The transportable criticality alarm system was developed at the Hanford Site in 1982 to comply with the requirements of US Department of Energy Order DOE 5480.1, 12/18/80 [1], and ANSI/ANS-8.3-1979 [2]. The portable unit that it replaced failed to comply with the new requirements in that it did not provide the necessary warning of malfunctions, nor did it provide the Hanford Site standard criticality alarm signal. Modern technology allowed the transportable criticality alarm system to comply with the criticality requirements cited and to incorporate other features that make it more usable, maintainable, and reliable. The transportable criticality alarm system provides temporary criticality coverage in manned areas where the facility criticality alarm system is not operable. This gamma radiation-sensitive system has been in use for the past 6 yr at the Hanford Site.

42598 (DOE/NCT–05, pp. 145-156) **MCNP [Monte Carlo Code for Neutron Photon Transport] calculations for detector locations.** Pruvost, N.L. (Los Alamos National Lab., NM (USA)); Schlesser, J.A.; West, J.T. III; Estes, G.P. Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The MCNP [Monte Carlo Code for Neutron & Photon Transport] code was used to generate time and energy spectra for neutron and photon transport throughout a fictitious facility. Calculations of this type will be utilized to design a new Los Alamos criticality alarm system.

42599 (DOE/NCT–05, pp. 163-172) **Definition of areas requiring criticality alarm annunciation and emergency control.** Hobson, J.M. (British Nuclear Fuels plc, Cheshire (England)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

The design of fissile material handling at British Nuclear Fuels plc requires the provision of a criticality incident detection system unless a specific case for omission can be formally made. Where such systems are provided, the 100 mSv contour resulting from a reference criticality incident must be restricted to an area of administrative control within which it is reasonably practicable to provide alarm annunciation and for which emergency arrangements can be defined. For typical reprocessing plant applications, the definition of these areas, and their restriction by provision of shielding where necessary, potentially requires a very large number of three dimensional neutron transport calculations in complex geometries. However, by considering the requirements and nature of this assessment, simple generic methods have been developed and justified. Consequently, rapid and inexpensive assessments of control areas can be carried out.

42600 (DOE/NCT–05, pp. 133-144) **Design of and experience with the gamma-detecting criticality accident alarm system at ALKEM MOX fuel fabrication plant.** Kindleben, G. (Hauptabteilung Sicherheitswesen, Hanau (West Germany)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

At ALKEM mixed oxide fuel fabrication plant there are two criticality accident alarm systems in operation and another one is planned for different buildings. They use ionization chambers for gamma-measuring. The measuring channels are self controlled with implemented test sources. The order of limit transgression at the detectors is registrated. The interpretation indicates the room of the radiation source, which is signaled by flash lights. Extensive radiation protection shieldings make detector-placing a complex problem with secondary gamma-radiation to be taken into account. Most of the appearing defects can easily be repaired by exchange of components. Some of them have been eliminated by technical modification. Redundancy prevents total system failure. Some false alarms occurred during the operation time of the alarm systems. The main reason is pulse induction, resulting from lightning strike. Measures to prevent such events have been taken, while further measures are being considered.

42601 (DOE/NCT–05, pp. 157-162) **An automated method for determining the areas covered by gamma sensitive criticality detectors.** Rittmann, P.D. (Westinghouse Hanford Co., Richland, WA (USA)). Lawrence Livermore National Lab., CA (USA). 1988. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). In *Transactions of the criticality alarm systems workshop.* Order Number DE90013080. Source: NTIS, PC A09/MF A01.

A description of the computer program LOCAS is given. LOCAS was developed at the Hanford site to assist in evaluating what areas in a facility are covered by the gamma-sensitive criticality detectors for various alarm trip settings. Detectors may be grouped into 2 of n sets, and there may be multiple sets. Representations of facility walls are stored in a wall library file, and detector coordinates may also be stored in a library file. Program output consists of numerical tables of dose rates and/or printhead graphics with print characters representing dose rates in a user-defined search plane. The primary limitations of the code are: (1) the assumed photon spectrum is that of prompt gammas from fission, without including the effect of neutron interactions, which tend to produce higher energy photons, and (2) limited inclusion of photon scattering through the use of dose buildup factors. For the purpose of evaluating the areas covered by a detector set, these limitations are conservative, i.e., they tend to underestimate the areas covered by the detection system.

42602 (IAEA-TECDOC–550, pp. 417-427) **Safety aspects of the UO_2 fuel cycle.** Lallement, R. (CEA, 75 - Paris (France)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The nuclear fuel cycle entails several necessary steps from the ore mining to the final disposal of the fission products. The public acceptance of the nuclear energy option depends on the safety of all the technological steps of the cycle. This paper intends to assess the main safety issues of enrichment, fuel fabrication, fuel reprocessing, transportation and waste disposal. It is shown that the safety problems in the fuel cycle are milder and easier to control than for the reactor case, because the amount of radioactivity involved in any step of the cycle is generally rather low. It does not mean that nothing has to be done to improve safety of the cycle. In the future, one can foresee a general trend to reduce the effluent

release from the reprocessing plants and a steady effort to solve the problem of long term storage of high activity-long life wastes. (author).

42603 (IAEA-TECDOC–550, pp. 429-444) **Safety aspects of the IFR pyroprocess fuel cycle.** Forrester, R.J. (Argonne National Lab., Idaho Falls, ID (USA)); Lineberry, M.J.; Solbrig, C.W.; Charak, I.; Tessier, J.H.; Gabor, J.D. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The Argonne National Laboratory Hot Fuel Examinations Facility-South (HFEF/S) located at INEL was designed more than 30 years ago to remotely reprocess and refabricate fuel elements for EBR-II. It is currently being modified and will be equipped with newly developed equipment to reprocess and refabricate EBR-II fuel elements that are a key part of the DOE Integral Fast Reactor (IFR) Program. This paper deals with the safety aspects of operating the HFEF/S as a major development facility in the IFR program. Facility modifications presented a great challenge to the analysts and designers since DOE required that such modifications meet current industry and DOE standards. One major result of this requirement was the design of a new safety-grade argon cell exhaust system that will assure that all accidental radionuclide releases from that cell are first filtered. Another significant effort was associated with seismic analyses required to assure the basic integrity of the structure following a design basis earthquake, even though the original facility was designed for minimal earthquake resistance using conventional building codes. A spectrum of credible accidents of varying likelihood was analyzed in order to estimate potential accidental radionuclide releases to the environment and assess their consequences to the public and facility workers. All such accidents were shown to have negligible consequences when credits for mitigative features are applied. Finally, criticality safety has received considerable attention. The project is attempting to design process equipment and procedures so that criticality-safety goes beyond current DOE and industry standards for highly-shielded operations. Project efforts are being directed toward ensuring that a criticality event is incredible. Nevertheless, the consequences to the public of an accidental criticality were evaluated and shown to be negligible.

42604 (UCRL-ID–103792) **Human factors evaluation and validation criteria for quality training programs: Development, presentation, and assessment.** Banks, W.W. Lawrence Livermore National Lab., CA (USA). 15 May 1990. 96p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014724. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This paper provides LLNL managers with a rigorous and quantitative human factors method for assessing the development and validity of any training program at the Lab. A secondary purpose is to provide a checklist for course developers and evaluators. The checklist is easy to use and comprehensive, and it helps ensure that critical components of a training program are adequately addressed. 15 refs., 6 figs.

42605 Design and analysis of free-standing spent fuel racks in nuclear power plants: An overview. Ashar, H. (Nuclear Regulatory Commission, Washington, DC (USA)); Degrassi, G. pp. 595-600 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

In order to accommodate the increasing inventory of spent fuel, the U.S. utilities started looking for various means to store spent fuel at the reactor sites. One of the most economical ways to accommodate more spent fuel is to arrange storage locations as closely as possible at the same time making sure that the fuel remains subcritical and that there are adequate means to cope with the heat load. This paper reports on the free standing high density rack configuration, an outcome of efforts to accommodate more fuel in the limited space.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 42395, 42402, 42558, 42705, 42706, 43129, 43617

42606 (KFK–4721) **The DoD Method.** Beyrich, W.; Golly, W.; Peter, N.; Seifert, R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1990. 50p. (EUR–11398-EN;PWA–15/90). Order Number DE90512941. Source: NTIS (US Sales Only), PC A03/MF A01.

The DoD method for robust estimating of variances of measurement series (time series) without the exclusion of outliers is described in detail, including its mathematical-statistical basis. In particular, it is proved that the total of all n(n-1)/2 absolute differences obtainable from n measurement values (realizations of random variables) may be subdivided into groups, each of them consisting of stochastically independent differences only. This is necessary for theoretical foundation of the DoDM estimator. Numerical examples of possible applications are given. Thereby, the evaluation of IDA-80 data presented earlier is completed applying the DoDM estimator. (orig.).

42607 (LA-UR–90-2259) **A demonstration of variance and covariance calculations using MAVARIC [Materials Accounting VARiance Calculator] and PROFF [PROcessing and Fuel Facilities calculator].** Barlich, G.L.; Nasseri, S.S. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–52: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90015097. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Good decision-making in materials accounting requires a valid calculation of control limits and detection sensitivity for facilities handling special nuclear materials (SNM). A difficult aspect of this calculation is determining the appropriate variance and covariance values for the terms in the materials balance (MB) equation. Computer software such as MAVARIC (Materials Accounting VARiance Calculator) and PROFF (PROcessing and Fuel Facilities calculator) can efficiently select and combine variance terms. These programs determine the variance and covariance of an MB equation by first obtaining relations for the variance and covariance of each term in the MB equation through propagating instrument errors and then substituting the measured quantities and their uncertainties into these relations. MAVARIC is a custom spreadsheet used with the second release of LOTUS 1-2-3.** PROFF is a stand-alone menu-driven program requiring no commercial software. Programs such as MAVARIC and PROFF facilitate the complex calculations required to determine the detection sensitivity of an SNM facility. These programs can also be used to analyze materials accounting systems.

42608 (LA-UR–90-2342) **Graph structure model.** Dreicer, J.S. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–43: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014930. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Graph Structure (GRPHSTRUC) model is a generic software-system tool that was developed to allow a system analyst to conduct studies and design analysis concerning control flow in graph structures. The GRPHSTRUC model is a knowledge-based expert system using icons and object-oriented methodologies. This software tool has been implemented on a Texas Instruments Explorer using the expert system shell called Knowledge Engineering Environment (KEE), Common Lisp methods, and KEE Pictures for

graphical display. The GRPHSTRUC model provides a user interface that is designed to allow the user to rapidly and efficiently represent graph components, interconnections, and interrelationships. GRPHSTRUC has been generically designed and developed to use classical graph theory and to allow the display of vertices and links of a graph structure. In particular, the model was developed to assist a computer security analyst in assessing the security of and to conduct security studies and design analysis concerning computer networks. The model is applicable to other disciplines that can be portrayed by graph structures, in particular safeguards. 16 refs.

42609 (LA-UR–90-2486) **An approach to safeguards for a nuclear materials plant.** Zack, N.R. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–37: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014898. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discusses a safeguards system that could be employed for a hypothetical nuclear material processing or production facility. The approach results in an integrated system of accountability measurements and nuclear materials control measures designed to monitor the storage, processing, and transfer of nuclear materials as well as placing adequate restraints upon personnel movement. It is the goal for every safeguards system, whether planned for a new facility or to be overlaid upon an existing facility, to be transparent to the plant operators, while accomplishing the necessary safeguards and security functions. This approach fulfills this need and presents graded protection to areas of varying sensitivity and accomplishes control at the source rather than placing increased reliance upon after-the-fact detection capabilities. These considerations will help a new or existing facility meet the new directions being established for safeguarding nuclear materials.

42610 (SAND–90-0667C) **The MIVS [Modular Integrated Video System] Image Processing System (MIPS) for assisting in the optical surveillance data review process.** Horton, R.D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007106–31: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014326. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The MIVS (Modular Integrated Video System) Image Processing System (MIPS) is designed to review MIVS surveillance data automatically and identify IAEA defined objects of safeguards interest. To achieve this, MIPS uses both digital image processing and neural network techniques to detect objects of safeguards interest in an image and assist an inspector in the review of the MIVS video tapes. MIPS must be "trained" i.e., given example images showing the objects that it must recognize, for each different facility. Image processing techniques are used to first identify significantly changed areas of the image. A neural network is then used to determine if the image contains the important object(s). The MIPS algorithms have demonstrated the capability to detect when a spent fuel shipping cask is present in an image after MIPS is properly trained to detect the cask. The algorithms have also demonstrated the ability to reject uninteresting background activities such as people and crane movement. When MIPS detects an important object, the corresponding image is stored to another media and later replayed for the inspector to review. The MIPS algorithms are being implemented in commercially available hardware: an image processing subsystem and an 80386 Personal Computer. MIPS will have a high-level easy-to-use system interface to allow inspectors to train MIPS on MIVS data from different facilities and on various safeguards significant objects. This paper describes the MIPS algorithms, hardware implementation, and system configuration. 3 refs., 10 figs.

42611 (SAND–90-0742C) **ARGUS-Demonstration of an integrated materials monitoring tracking and accounting system.** Henslee, S.P. (Argonne National Lab., IL (USA)); Jackson, B.G.; Garcia, B.; Bearse, R.C.; Tisinger, R.M.; Ballmann, J. Sandia National Labs., Albuquerque, NM (USA); Argonne National Lab., IL (USA); Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789 ;W-31109-ENG-38 ;W-7405-ENG-36. (CONF-9007106–33: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990; LA-UR–90-2487). Order Number DE90014369. Source: NTIS, PC A03/MF A01 - OSTI.

The Argonne Unified Safeguard (ARGUS) System is currently in the process of being demonstrated as a functioning integrated materials monitoring/tracking and accounting system in the Fuel Manufacturing Facility (FMF) located at Argonne National Laboratory (ANL) in Idaho Falls, Idaho. ARGUS is the product of an interlaboratory project with Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), and ANL. Accounting and communications software were developed by LANL personnel while materials monitoring and tracking software and hardware were developed by SNL personnel. ANL has provided project coordination, operational support and the facility that serves as the test bed for this demonstration. The ARGUS system is made up of three major components. These components perform the functions of observing all container movements, authorized materials access approval, initiation and receipt of materials transfers, and perform materials accounting for the facility. ARGUS system benefits can be summarized as follows: near real-time accountability, full traceability of materials access and transfer, enforcement of approved personnel access to materials, electronic confirmation of materials surveillance procedures during materials access and transfers, and continuous surveillance of all material not directly involved in the manufacturing process. 4 refs., 1 fig., 1 tab.

42612 (SAND–90-0773C) **International standards for physical protection revising INFCIRC/225.** Kessler, J.C. (Department of State, Washington, DC (USA)); Mangan, D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007106–36: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014564. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the 1970s concern over potential sub-national threats to civil nuclear activities led the IAEA to convene several meetings of experts to formulate recommendations for adequate physical protection. This activity culminated in the 1978 publication of "The Physical Protection of Nuclear Materials" as INFCIRC/225/Rev. 1, which became the accepted international standard. It was incorporated in national regulations and in nuclear supply and bilateral cooperation agreements, and it formed the basis for the levels of physical protection mandated by the convention on the Physical Protection of Nuclear Materials. In the ensuing decade INFCIRC/225/Rev. 1 served the international community well, but a number of developments, in our understanding of the threat, in the technology available to security system designers, and in the industry to be protected, led to a widespread view that the time for a review had come. The US played a leading role in that review. This paper will describe the process leading to the Technical Committee Meeting on Physical Protection convened by the Director General in the spring of 1989, provide an overview of the issues considered by that group, and identify the areas in which the Committee modified the international guidelines, now reflected in INFCIRC/225/Rev. 2 published by the IAEA in December 1989. 5 refs.

42613 (SAND–90-0942) **Instructions for the use of the Modular Integrated Video System (MIVS).** Schneider, S.L. Sandia National Labs., Albuquerque, NM (USA). Mar 1990. 50p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. IMI-56-Rev.0. Order Number DE90013593. Source: NTIS, PC A04/MF A01 - OSTI.

This MIVS instruction manual provides a detailed description of all the capabilities that this system can perform. It provides step by step instruction for setting up the system parameters and the procedure for initiating surveillance. This information complements the training received prior to field operation of this system. 6 figs., 13 tabs.

42614 (SAND–90-0943) **Modular Integrated Video System (MIVS) maintenance manual.** Schneider, S.L. Sandia National

Labs., Albuquerque, NM (USA). Mar 1990. 53p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. MM01. Order Number DE90013592. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

To assist in the repair of the Modular Integrated Video System (MIVS) printed circuit boards, a maintenance or service manual is essential. This manual provides a simplified overview of each PC board and explains the functions of each component. Setup procedures and parts lists for each board are included to minimize the task of aligning the boards and identifying replacement parts.

42615 (UCID–21795) **Structured approach for resolving SNM [special nuclear material] anomalies.** Lamont, A.; Strait, R.S. Lawrence Livermore National Lab., CA (USA). Oct 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014730. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nuclear facilities are responsible for resolving nuclear materials safeguards anomalies that indicate that special nuclear material (SNM) may be missing. These anomalies acts by insiders. Determining the likely cause of an anomaly is often complex, time-consuming, and costly. In most cases, no specific cause can be conclusively proven. Currently there are no standardized methods available for guiding an investigation and drawing conclusions from it. This report presents a method we are developing, which is based on decision analysis techniques and Bayesian probability analysis. The method helps develop a set of hypotheses about the possible causes of an anomaly and uses the evidence gathered during an investigation to evaluate the likelihood of each hypothesis. The uncertainty in measurements and evidence collection are accounted for in an explicit and quantitative manner. The method suggests the most effective sequence of steps for the investigation and provides guidance on when to terminate the investigation. A simple computer program and training materials are also being developed. The software is being designed to facilitate quick resolution of an anomaly, help guide an investigation team, and document conclusions. 4 figs.

0560 Legislation and Regulations

Refer also to citation(s) 42536, 42720, 42775

42616 (OEFZS-A–1682) **Regulations for the safe transport of radioactive materials on roads.** Neubauer, J. (Bundesministerium fuer oeffentliche Wirtschaft und Verkehr (Austria)); Laszerus, C.; Kafka, G. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Hauptabteilung Abfallverarbeitung. Apr 1990. 185p. (In German). (AV–23/90). Source: Available from the Austrian Research Centre Seibersdorf, A-2444 Seibersdorf (Austria).

Limited Distribution.

In order to facilitate the use of regulations for the safe transport of radioactive materials on roads in Austria the regarding regulations are summarized and commented. Several examples of national and international transports demonstrate the application of the regulations and transmit the informations necessary. 23 tabs., 5 figs. (Authors).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

42617 (WKI–21) **Moisture measurement in wood, wood-based materials and building materials - a literature review.** Kober, A.; Mehlhorn, L.; Plinke, B. Fraunhofer-Institut fuer Holzforschung - Wilhelm-Klauditz-Institut -, Braunschweig (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Oct 1989. 118p. (In German). Contract BMFT BAU 7018B8. Source: Copy held by UB/TIB Hannover.

Methods of moisture measurement in solid substances, especially on wood, wood-based materials and building materials were examined and evaluated according to the literature available. The question was which methods of examining the moisture distribution in building elements at climate loading offer the best accuracy and spatial resolution as well as which methods are the most appropriate at present and in future for the solution of measurement problems in the wood and wood-based industry. The most common methods are electric measurement methods which are utilizing either the moisture-depending conductivity or the dielectric constant or the reflectivity of the material for infrared radiation but they offer only a limited accuracy. The same is valid for the rarely used microwave methods or X-ray and NMR tomography. Simple electric methods will further on play an important role in the industrial process measuring technique. For the examination of building elements, methods using nuclear radiation still offer possibilities for a further development. (orig.) With 207 refs., 13 figs.

08 HYDROGEN

0801 Production

Refer also to citation(s) 42868

0802 Storage, Transport, and Handling

42618 (STU–87-3334) **Metal hydrides as agents for hydrogen storage.** Noreus, D. (Stockholm Univ. (SE). Strukturkemi). Swedish National Board for Technical Development, Stockholm (Sweden). 28 Jun 1989. 8p. (In Swedish). Order Number DE90512618. Source: NTIS (US Sales Only), PC A02/MF A01.

The main object of the investigation was to study hydrides containing transition metal/hydrogen complex. These hydrides can attain a high hydrogen content. They are prepared by combining electropositive alkali or alkali earth metals with a transition metal. The electropositive metal donates electrons to the transition metal that it can use to bond hydrogen in a metal/hydrogen complex. Examples are Mg_2NiH_4, Mg_2CoH_5, Mg_2FeH_6 and others. The main result of the project is the establishment of the properties of these hydride being strongly dependent of the formal oxidation member of the transition metal. In the $Li_2PdH_2^-$ and Na_2Pd_2 hydrides the alkali metal valence electrons are not completely transfered to the palladium/hydrogen complex. The bond between the alkali metals and the complex remains metallic and provides the hydrides with properties that resemble the alkali metals. Hydrides are obtained that are metallic and fusable at relatively low temperatures, 510 and 390 degrees C for $LiPdH_2$ and Na_2PdH_2 respectively. Unfortunately palladium is a far too rare metal for the detection of these hydrides to represent a break-through for the use of metal hydrides in certain heat pumps. A corresponding hydride is Mg_2NiH_4 which contains a form of zero-valent nickel/hydrogen complex. Mg_2NiH_4 was early discussed as a possible agent for hydrogen storage. A drawback with the hydride was the strong bond between hydrogen and the metal lattice. The reason for the stability is the hydride forming domains in its lattice where the structure in adjacert domains is characterized of being the reflected images of each others. The thickness of the domains is only some 10A and is a method of the hydride of solving the above mentioned problem with high electron density on the formally zero-valent nickel atoms. (Abstract Truncated)

09 BIOMASS FUELS

Refer also to citation(s) 43316

0907 Resources

Refer also to citation(s) 43290

0908 Production

42619 (CONF-900901–2) **Woody biomass production costs in the United States: An economic summary of commercial Populus plantation systems.** Strauss, C.H. (Pennsylvania State Univ., University Park, PA (USA)); Wright, L.L. Oak Ridge National

Lab., TN (USA). [1990]. 9p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From World renewable energy congress; Reading (UK); 23-28 Sep 1990. Order Number DE90014449. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Production costs for commercial-sized Populus plantations were developed from a series of research programs sponsored by the US Department of Energy's Short Rotation Woody Crops Program. Populus hybrid planted on good quality agricultural sites at a density of 2100 cuttings ha^{-1} was projected to yield an average of 16 Mg (OD) $ha^{-1}yr^{-1}$. Discounted cash flow analysis of multiple rotations showed production costs of $17 (US) Mg^{-1}(OD). 10 refs., 2 tabs.

0909 Processing

Refer also to citation(s) 42372, 43039

42620 (Juel–2325) **Computer-aided optimation and process control of continuous biotechnical processes - anaerobic waste water purification.** Schuerbuescher, D. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Biotechnologie; Technische Hochschule Aachen (Germany, F.R.). Nov 1989. 160p. (In German). Order Number DE90513106. Source: NTIS (US Sales Only), PC A08/MF A01.

On the basis of test results a mathematical model for the methanisation phase of anaerobic waste water purification was set up and used for further simulations. A continuously working adaptive pH-controller was used. It guarantees auxostatic process control and a very precise maintenance of a defined pH-value with continuously running substrate pump. A automatised method of optimising the temperature of continuous biotechnical processes was developed. The pH-value was kept constant by adapting the flow rate by means of the parameter-adaptive controller. This produced a cause-effect-relation between temperature and reactor output. The relation was observed and evaluated online via a pattern-recognition program and used for the further control decisions in such a way as to increase the output during the period of the test while avoiding any short-term damaging of the cultures. Performance increases of up to 30% were achieved that way. Balancing of the biogas flow allowed online calculation and precise control of the substrate concentration. Manual input of off-line measured values biogas amount and substrate concentration at irregular times were also integrated in the control concept. (orig./EF).

42621 (STEV-FGT–90-2) **Bio-gasification LTH. Final report, step 7.** Andersson, L. (Lund Univ. (SE). Dept. of Chemical Engineering 2); Bjerle, I.; Forkman, M.; Hallgren, A.; Holst, L. Statens Energiverk, Stockholm (Sweden). Nov 1989. 90p. (In Swedish). Project STEV-136-026. Order Number DE90512648. Source: NTIS (US Sales Only), PC A05/MF A01.

The report includes four sections: * Gasification of biomass in a drop tube furnace, * Thermogravimetric investigation of biomass char, * H_2S separation at high temperatures by means of calcium absorbents, * Calculation model for heat transfer and dwell in a drop tube furnace. Separate abstracts have been prepared for the four sections. (O.S.).

42622 (STEV-FGT–90-2, pp. 1:1-12) **Gasification of biomass in a drop tube furnace.** Hallgren, A. (Lund Univ. (SE). Dept. of Chemical Engineering 2); Andersson, L.A.; Bjerle, I. Statens Energiverk, Stockholm (Sweden). Nov 1989. (In Swedish). Project STEV-136-026. In *Bio-gasification LTH. Final report, step 7.* Order Number DE90512648. Source: NTIS (US Sales Only), PC A05/MF A01.

The aim of the present investigation of steam gasification is mainly to study the influence on gas production (quantity, composition) for different temperatures, dwells, and partial pressure of steam and nitrogen in a drop tube furnace. The range of temperature in the experiments was 1000-1400 deg C, range of dwell 0.25-1 sec, and range of water vapor/nitrogen partial pressure ratio 25/75 to 75/25. The degree of burnup increases with increasing dwell. Highest burnup is found at the highest tmperatures. In CO_2 atmosphere the degree of burnup is slightly higher than in N_2 atmosphere. In the steam experiments is shown that a long dwell as well as a high water vapor partial pressure increases burnup. The product gas consists mainly of carbon monoxide and hydrogen, but ca 10% each of carbon dioxide and methane are also found. Hydrocarbons like ethene, acetylene and ethane are also found, but only in a total amount of less than 5%. The experiments in water vapor atmosphere show that a change in steam partial pressure has a very small effect on the composition of the product gas for the temperature range studied. (O.S.) (7 figs.).

42623 (STEV-FGT–90-2, pp. 4:1-18) **Calculation model for heat transfer and residence time in a drop tube furnace.** Statens Energiverk, Stockholm (Sweden). Nov 1989. (In Swedish). Project STEV-136-026. In *Bio-gasification LTH. Final report, step 7.* Order Number DE90512648. Source: NTIS (US Sales Only), PC A05/MF A01.

To be able to calculate the kinetics of the reactions in a drop tube furnace with greater accuracy, estimations of temperature and residence time of the falling particles are desirable. A program for these calculations is under development. A sub-program is now available for estimation of heat transfer from gas to particles and the drop velocity of the particles. Also available is a sub-program for estimation of the physical properties of the gas. (O.S.).

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42619

0980 Waste Management

42624 (DOE/OR/21389–25) **Northeast regional biomass energy program: Progress report, January 1990–March 1990.** O'Connell, R.A. CONEG Policy Research Center, Inc., Washington, DC (USA). Apr 1990. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG05-83OR21389. Order Number DE90015074. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The management structure and program objectives for the Northeast Regional Biomass Program remain unchanged from previous years. The funding for this year however has been considerably reduced permitting the issuance of grants to states to be held to $15,000/state. To alleviate this condition, $120,000 of unobligated state grant funds has been transferred to the technical subcontract area. Technical projects have been selected by the Steering Committee. Work statements are in preparation. The final report entitled "Energy Implications of Alternative Solid Waste Management Systems" has been prepared and copies have been distributed to NRBP states. An overview of the findings are as follows: all but three states (DE, ME, MA) show positive waste management systems balance, incinerator goals are the single largest contributor to systems balance, significant projected energy savings through waste recycling operations, recycling waste leads to reduced energy use for operations, recycling yields a higher value fuel and less ash, infrastructure to handle planned recyclables will require major improvements, and several cases of inconsistency in State MSW Plans.

0990 Products and By-Products

Refer also to citation(s) 42619

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 42323, 42372

42625 (DOE/PC/88933–6) **Alkali/TX_2 catalysts for CO/H_2 conversion to C_1-C_4 alcohols: Technical progress report, March–May 1990.** Klier, K.; Herman, R.G.; Richards, M.; Bastian, R.D. Lehigh Univ., Bethlehem, PA (USA). Zettlemoyer Center for Surface Studies. Jun 1990. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88933. Order Number DE90015369. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this research is to investigate and develop novel catalysts for the conversion of coal-derived synthesis gas into C_1-C_4 alcohols by a highly selective process. Therefore, the variations of catalyst activity and selectivity for the synthesis of alcohols from $H_2/CO \leq 1$ synthesis gas for a series of A/TX_2 compounds, where A is a surface alkali dopant, T is a transition metal, and X is a S, Se, or Te, will be determined. The alkali component A, which is essential for C-O and C-C bond forming reactions leading to alcohols, will be highly dispersed on the TX_2 surfaces by using chemical vapor deposition (CVD) and chemical complexation/anchoring (CCA) methods. This quarter, the newly prepared catalysts RuS_2 and Li_2S have been characterized by the surface sensitivity technique of HR-ESCA using the SCIENTA ESCA-300 instrument. Examination of the valence band spectra, obtained at low binding energies where mixing of bonding orbitals occur, demonstrated that insight into the d orbital levels can be obtained. The planar surface of a single crystal of MoS_2 was also probed by diffraction experiments in HR-ESCA in terms of forward focusing of the escaping photoelectrons. Preliminary confirmation of the forward focusing mechanism was obtained. In addition, the experimental results demonstrate the great promise for the determination of surface structure by HR-ESCA. 4 refs., 4 figs.

1003 Properties and Composition

42626 (Juel–2338) **Method for kinetic control of methane oxidation.** Wilms, M. Forschungszentrum Juelich GmbH (KFA) (Germany, F.R.). Inst. fuer Energieverfahrenstechnik; Technische Hochschule Aachen (Germany, F.R.). Jan 1990. 146p. (In German). Order Number DE90510281. Source: NTIS (US Sales Only), PC A07/MF A01.

Controlled oxidation of methane into methanol is carried out in an experimental facility whose projecting and construction is described. A reaction model is established on the basis of a bibliographic study and compared with the results of the laboratory experiments. (EF).

13 HYDRO ENERGY

1302 Site Geology and Meteorology

42627 **Uplift criteria for existing concrete gravity dams: Past, present and future.** Foster, J.L. (USDOE Federal Energy Regulatory Commission, Washington, DC (USA)). *Proceedings of the American Power Conference (USA),* 51: 766-771 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper presents an overview of uplift criteria for existing concrete gravity dams. The author concludes that, for existing dams, the use of design based criteria can be over conservative if drain efficiencies are underestimated, or can be non-conservative if site specific foundation problems are not considered.

1303 Plant Design and Operation

42628 (LUTFD2-TFRT–5402-1-60-1989) **Digital turbine controller for small water power units.** Davidsson, P.A. Lund Univ. (Sweden). Dept. of Automatic Control. Jun 1989. 65p. (In Swedish). Order Number DE90512591. Source: NTIS (US Sales Only), PC A04/MF A01.

Examination paper.

This master thesis contains a study of the design of a simple regulator for small water power units.

1305 Economic, Industrial and Business Aspects

Refer also to citation(s) 42859

14 SOLAR ENERGY

1403 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42878

1404 Environmental Aspects

Refer also to citation(s) 43276

1405 Solar Energy Conversion

Refer also to citation(s) 43014, 43021, 43279, 43280, 43311, 43312, 43337

42629 (BNL–44777) **Photovoltaic environmental, health and safety electronic bulletin board service.** Meinhold, A.F.; Moskowitz, P.D. Brookhaven National Lab., Upton, NY (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900542–14: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90015093. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An electronic bulletin board system (BBS) has been established by the Biomedical and Environmental Assessment Group, Brookhaven National Laboratory, for the Photovoltaics Technology Division, US Department of Energy. The purpose of the BBS is to provide a forum for the ongoing exchange of information relating to the environmental, health and safety aspects of photovoltaic cell manufacture. This BBS is available, at no charge, to organizations engaged in photovoltaic cell research, development and production. Individuals with access to a microcomputer, modem and communications software can call into the BBS and join ongoing discussions. Users of the BBS may also electronically access reports, models and databases which relate to the environmental, health and safety aspects of photovoltaic cell manufacture. 6 figs.

42630 (N–90-21812) **Photovoltaic power for space station freedom.** Baraona, C.R. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 8p. (NASA-TM–102569;E–5391;NAS–1.15:102569;CONF-900542–: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Source: NTIS, PC A02/MF A01.

Space Station Freedom is described with special attention given to its electric power system. The photovoltaic arrays, the battery energy storage system, and the power management, and distribution system are also discussed. The current design of Freedom's power system and the system requirements, trade studies, and competing factors which lead to system selections are referenced. This will be the largest power system ever flown in space. This system represents the culmination of many developments that have improved system performance, reduced cost, and improved reliability. Key developments and their evolution into the current space station solar array design are briefly described. The features of the solar cell and the array including the development, design, test, and flight hardware production status are given.

42631 (N–90-22488) **Space Station Freedom solar array panels plasma interaction test facility.** Martin, D.F.; Mellott, K.D. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 14p. (NASA-TM–102475;E–5262;NAS–1.15:102475;CONF-8910358–: Spacecraft charging technology conference, Monterey, CA (USA), 31 Oct - 3 nov 1989). Source: NTIS, PC A03/MF A01.

The Space Station Freedom Power System will make extensive use of photovoltaic (PV) power generation. The phase 1 power system consists of two PV power modules each capable of delivering 37.5 KW of conditioned power to the user. Each PV module consists of two solar arrays. Each solar array is made up of two solar blankets. Each solar blanket contains 82 PV panels. The PV power modules provide a 160 V nominal operating voltage. Previous research has shown that there are electrical interactions between a plasma environment and a photovoltaic power source. The interactions take two forms: parasitic current loss (occurs

when the current produced by the PV panel leaves at a high potential point and travels through the plasma to a lower potential point, effectively shorting that portion of the PV panel); and arcing (occurs when the PV panel electrically discharges into the plasma). The PV solar array panel plasma interaction test was conceived to evaluate the effects of these interactions on the Space Station Freedom type PV panels as well as to conduct further research. The test article consists of two active solar array panels in series. Each panel consists of two hundred 8 cm x 8 cm silicon solar cells. The test requirements dictated specifications in the following areas: plasma environment/plasma sheath; outgassing; thermal requirements; solar simulation; and data collection requirements.

42632 (N–90-22843) **Lateral spreading of Au contacts on InP.** Fatemi, N.S.; Weizer, V.G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 10p. (NASA-TM–103133;E–5472;NAS–1.15:103133;CONF-900486–: Spring meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Source: NTIS, PC A02/MF A01.

The contact spreading phenomenon observed when small area Au contacts on InP are annealed at temperatures above about 400 C was investigated. It was found that the rapid lateral expansion of the contact metallization which consumes large quantities of InP during growth is closely related to the third stage in the series of solid state reactions that occur between InP and Au, i.e., to the Au3In-to-Au9In4 transition. Detailed descriptions are presented of both the spreading process and the Au3In-to-Au9In4 transition along with arguments that the two processes are manifestations of the same basic phenomenon.

42633 (SERI/TP–211-3804) **Research on high-efficiency, multiple-gap, multi-junction amorphous silicon-based alloy thin-film solar cells: Phase 3, Semi-annual subcontract report, March 1, 1989–August 31, 1989.** Guha, S. (Energy Conversion Devices, Inc., Troy, MI (USA)). Solar Energy Research Inst., Golden, CO (USA). Jul 1990. 49p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000338. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This research program is directed toward the advancement of understanding of amorphous silicon-based alloys and their use in small area multi-junction solar cells. The program is divided into subtasks on materials research, single-junction solar cell research, and multi-junction solar cell research. In this report we discuss progress made during the period from March through August 1989. A major focus of the program was to achieve improvement in the performance of the back reflector and the antireflection coating to optimize cell performance. Computer simulation work was also carried out to analyze performance trade-offs between triple and tandem a-Si alloy solar cells. 10 refs., 27 figs., 5 tabs.

42634 Colloidal semiconductors as photocatalysts for solar energy conversion. Kamat, P.V. (Notre Dame Radiation Laboratory, IN (USA)); Dimitrijevic, N.M. *Solar Energy (Journal of Solar Energy Science and Engineering) (USA),* 44(2): 83-98 (1990).

Considerable attention has been drawn in recent years to develop ultrafine semiconductor particles which exhibit excellent photocatalytic properties. Size quantization effects, nonlinear optical properties and enhanced photoredox properties make quantized colloidal semiconductors potentially useful in the design of photoelectrochemical systems. Photochemical and photophysical processes that directly influence the photocatalytic properties of the semiconductor colloids and the factors that limit the charge transfer at the semiconductor/electrolyte interface are discussed here. Applications of semiconductor particulate systems in the conversion and storage of solar energy are also described.

42635 Space plasma induced arcing on HV solar arrays. Katz, I. (S-Cubed Division, Maxwell Lab., La Jolla, CA (US)); Jongeward, G.A.; Davis, V.A.; Parks, D.E.; Snyder, D.B. *IEEE Transactions on Microwave Theory and Techniques (Institute of Electrical and Electronics Engineers) (USA),* 38(4): 367-370 (Apr 1990).

The authors review the interactions between HV systems and the low-earth-orbit environment. The mechanism responsible for the observed arcing on negatively-biased solar arrays is discussed, and calculations of the plasma density dependence on de voltage threshold are compared with experiments. For positively biased systems, they discuss the enhancement of current collection resulting from neutral ionization within the electron collection sheath. Numerical simulations for the effect are also presented. The authors discuss the altitude and voltage range in which these two effects will be important. Techniques are presented to ameliorate these effects.

1406 Photovoltaic Power Systems

Refer also to citation(s) 42635, 43276

1407 Solar Thermal Power Systems

Refer also to citation(s) 43276

42636 (SAND–90-0009C) **Evaluation of the STM4-120 kinematic Stirling engine.** Linker, K.L.; Rawlinson, K.S.; Smith, G. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900801–23: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90013836. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Department of Energy's (DOE) Solar Thermal Program has identified the Stirling cycle heat engine as the conversion device for dish-electric systems with the most potential for meeting the program's goals. To advance the technology toward commercialization in a dish-electric system, Sandia National Laboratories has acquired a Stirling Thermal Motors, Inc. kinematic Stirling engine, STM4-120, for evaluation. During the past year this engine has been operating at Sandia's Engine Test Facility. The engine's heat input has been provided through fossil fuel combustion and sodium heat pipes, while the output power has been absorbed with an eddy-current dynamometer. This paper presents the evaluation of the engine performance during the past year. 8 refs., 7 figs., 1 tab.

42637 Ammonium sulfate solar pond: Observations from small-scale experiments. Hull, J.R. (Argonne National Laboratory, IL (USA)); Bushnell, D.L.; Sempsrote, D.G.; Pena, A. *Solar Energy (Journal of Solar Energy Science and Engineering) (USA),* 43(1): 57-64 (1989).

Using the fertilizer salt $(NH_4)_2SO_4$, the authors established a salinity gradient solar pond in a small outdoor tank. The hydrodynamic and thermal behavior of the pond was similar to that observed in the past for solar ponds containing NaCl. For temperature gradients between 50 and 300 K/m and salinity gradients between 200 and 1400 kg/m^4, data relating the gradients to erosion and growth of the gradient zone were generally consistent with the Nielsen boundary criterion for NaCl. With a salinity difference of 20% between the upper and lower zones and a maximum lower-zone temperature of 83°C, no instabilities were observed in the interior of the gradient zone. Sodium hypochlorite was effective in controlling algal populations and maintaining good brine transparency.

1409 Solar Thermal Utilization

42638 Performance studies for an experimental solar open-cycle liquid desiccant air dehumidification system. Patnaik, S. (Colorado State Univ., Fort Collins (USA)); Lenz, T.G.; Loef, G.O.G. *Solar Energy (Journal of Solar Energy Science and Engineering) (USA),* 44(3): 123-135 (1990).

A nominal 10.5-kW (3-ton) open-cycle liquid desiccant dehumidification system has been designed, installed, and successfully operated at the Solar Energy Applications Laboratory, Colorado State University. Packed beds units were used to dry the air in the dehumidifier and to concentrate the desiccant in the regenerator. Liquid distribution in the regenerator was studied for two systems: a gravity tray distributor, and a spray nozzle system. Higher capacities (40-50% increase) and lower pressure drop (30-40% reduction) for the air flow were observed with the spray system. Cooling capacities of 3.5-14.0 kW (1.0-4.0 refrigeration tons) were

achieved for both the regenerator and dehumidifier. Functional relationships correlating the independent variables to the rate of vaporization in the regenerator and rate of condensation in the dehumidifier were obtained by statistical analysis of the experimental data. These studies thus provide data and correlations useful for design guidance and performance analysis of similar open-cycle liquid desiccant cooling systems, particularly for the liquid/vapor contact units.

1410 Solar Collectors and Concentrators

42639 (N–90-22834) **Solar concentrator advanced development program. Final report.** Knasel, D.; Ehresman, D. Harris Corp., Melbourne, FL (USA). Oct 1989. 333p. (NASA-CR–185173;NAS–1.26:185173). Source: NTIS, PC A15/MF A02; 1 functional color page.

Original contains color illustrations.

The Solar Concentrator Advanced Development Project has successfully designed, fabricated, and tested a full scale prototypical solar dynamic concentrator for space station applications. A Truss Hexagonal Panel reflector was selected as a viable solar concentrator concept to be used for space station applications. This concentrator utilizes a modular design approach and is flexible in attainable flux profiles and assembly techniques. The detailed design of the concentrator, which included structural, thermal and optical analysis, identified the feasibility of the design and specific technologies that were required to fabricate it. The needed surface accuracy of the reflectors surface was found to be very tight, within 5 mrad RMS slope error, and results in very close tolerances for fabrication. To meet the design requirements, a modular structure composed of hexagonal panels was used. The panels, made up of graphite epoxy box beams provided the strength, stiffness and dimensional stability needed. All initial project requirements were met or exceeded by hardware demonstration. Initial testing of structural repeatability of a seven panel portion of the concentrator was followed by assembly and testing of the full nineteen panel structure. The testing, which consisted of theodolite and optical measurements over an assembly-disassembly-reassembly cycle, demonstrated that the concentrator maintained the as-built contour and optical characteristics. The facet development effort within the project, which included developing the vapor deposited reflective facet, produced a viable design with demonstrated optical characteristics that are within the project goals.

42640 (SAND–89-2840) **Test Bed Concentrator No.1 calorimetry results.** Rawlinson, K.S.; Dudley, V.E. Sandia National Labs., Albuquerque, NM (USA). Feb 1990. 36p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90014747. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Calorimetry was performed on Sandia National Laboratories' Test Bed Concentrator #1 (TBC-1) during late July and early August 1989. The purpose of the tests was to determine the total power available from the concentrator and the amount of the total power that can be focused through a 22-cm aperture plate located at the nominal focal point of the dish. The 22-cm aperture corresponds to the diameter of several reflux receivers that are currently under development, fabrication and testing at Sandia. The calorimeter test will allow the efficiency of the sodium reflux receivers to be calculated. The total power (normalized to 1000 W/m^2) available from TBC-1 is 66.4 kW into the 22-cm aperture plate. Within error limits, this power level is the same with or without the aperture plate. The power levels stated are for this time (July 1989) and will probably change as the mirrors further degrade. Since the last calorimetry tests were performed, the mirror facets have degraded significantly, and the results presented here support this effect. Finally, three of the 220 facets were missing. 3 refs., 5 figs., 2 tabs.

42641 (SLU-LBT–161) **Field test of solar collectors for drying of grain and hay.** Pahlman, T. Swedish National Board for Technical Development, Stockholm (Sweden); Swedish Univ. of Agricultural Sciences, Lund (Sweden). Dept. of Farm Buildings. 1988. 68p. (In Swedish). (STU–87-2643). Order Number DE90512624. Source: NTIS (US Sales Only), PC A04/MF A01.

The aims of the investigation were to determine how these types of solar collectors are aged and how this aging process is affecting their function. The investigation included five farms with three types of solar collectors for hay and grain drying. The investigation was carried out in July/August 1986. Solar radiation, air temperature, air movement and pressure were measured. Also the dimensions of the solar collectors and the driers were measured. The study shows that the dimensions of the solar collectors rather have been determined by the sizes of the existing buildings than by the airflow needs of the driers or by an effort to optimize the performances of the solar collectors. One of the collectors had a central air outlet. Measures showed that the air flow through the solar collector was uneven. Existing construction guidelines concerning the design of the air ducts are very defective. Two of the farms had solar collectors with cover plates of glass fibre reinforced polyester. The constructions were 7-9 years old. Clear ageing phenomena such as crackling, cracking of the glass fibres, covers of mosses etc led to clearly less good function in course of time. (41 illustrations, 10 tabs.).

1420 Heat Storage

42642 (N–90-21974) **Analysis of thermal energy storage material with change-of-phase volumetric effects.** Kerslake, T.W.; Ibrahim, M.B. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Feb 1990. 34p. (NASA-TM–102457;E–5244;NAS–1.15:102457;CONF-900449–: 12. annual American Society of Mechanical Engineers (ASME) international solar energy conference, Miami, FL (USA), 1-4 Apr 1990). Source: NTIS, PC A03/MF A01.

NASA's Space Station Freedom proposed hybrid power system includes photovoltaic arrays with nickel hydrogen batteries for energy storage and solar dynamic collectors driving Brayton heat engines with change-of-phase Thermal Energy Storage (TES) devices. A TES device is comprised of multiple metallic, annular canisters which contain a eutectic composition LiF-CaF2 Phase Change Material (PCM) that melts at 1040 K. A moderately sophisticated LiF-CaF2 PCM computer model is being developed in three stages considering 1-D, 2-D, and 3-D canister geometries, respectively. The 1-D model results indicate that the void has a marked effect on the phase change process due to PCM displacement and dynamic void heat transfer resistance. Equally influential are the effects of different boundary conditions and liquid PCM natural convection. For the second stage, successful numerical techniques used in the 1-D phase change model are extended to a 2-D (r,z) PCM containment canister model. A prototypical PCM containment canister is analyzed and the results are discussed.

15 GEOTHERMAL ENERGY

1501 Resources and Availability

42643 (DOE/ID/12784–1) **Geothermal fluid genesis in the Great Basin: Final report, 1 August 1988–1 May 1990.** Flynn, T.; Buchanan, P.K. Nevada Univ., Reno, NV (USA). Div. of Earth Sciences. [1990]. 154p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG07-88ID12784. Order Number DE90014438. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Early theories concerning geothermal recharge in the Great Basin implied recharge was by recent precipitation. Physical, chemical, and isotopic differences between thermal and non-thermal fluids and global paleoclimatic indicators suggest that recharge occurred during the late Pleistocene. Polar region isotopic studies demonstrate that a depletion in stable light-isotopes of precipitation existed during the late Pleistocene due to the colder, wetter climate. Isotopic analysis of calcite veins and packrat midden megafossils confirm the depletion event occurred in the Great Basin. Isotopic analysis of non-thermal springs is utilized as a proxy for local recent precipitation. Contoured plots of deuterium concentrations from non-thermal and thermal water show a regional, systematic variation. Subtracting contoured plots of non-thermal water from plots of thermal water reveals that thermal waters on a regional scale are generally isotopically more depleted.

Isolated areas where thermal water is more enriched than non-thermal water correspond to locations of pluvial Lakes Lahontan and Bonneville, suggesting isotopically enriched lake water contributed to fluid recharge. These anomalous waters also contain high concentrations of sodium chloride, boron, and other dissolved species suggestive of evaporative enrichment. Carbon-age date and isotopic data from Great Basin thermal waters correlate with the polar paleoclimate studies. Recharge occurred along range bounding faults. 151 refs., 62 figs., 15 tabs.

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 43278

42644 (LBL–26869) **Hydrogeologic model of the Ahuachapan geothermal field, El Salvador.** Laky, C. (Lawrence Berkeley Lab., CA (USA)); Lippmann, M.J.; Bodvarsson, G.S.; Retana, M.; Cuellar, G. Lawrence Berkeley Lab., CA (USA). Jan 1989. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-890114–7: 14. workshop on geothermal reservoir engineering, Stanford, CA (USA), 24-26 Jan 1989). Order Number DE90015304. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A hydrogeological model of the Ahuachapan geothermal field has been developed. It considers the lithology and structural features of the area and discerns their impact on the movement of cold and hot fluids in the system. Three aquifers were identified, their zones of mixing and flow patterns were obtained on the basis of temperature and geochemical data from wells and surface manifestations. 12 refs., 9 figs.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 42645

1508 Geothermal Power Plants

Refer also to citation(s) 42643

1509 Geothermal Engineering

42645 (DOE/NV/10412–2) **Consolidated research program, United States Gulf Coast geopressured-geothermal program: 1988-89 annual report.** Texas Univ., Austin, TX (USA). Center for Petroleum and Geosystems Engineering. Jun 1990. 241p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-85NV10412. Order Number DE90014398. Source: NTIS, PC A13/MF A01 - OSTI; GPO Dep.

This document describes a number of tests and their results performed at geothermal sites in Texas, Louisiana and California. Tests were performed to determine the effect boron has on rock porosity in West Texas; well logging was performed at Hulin #9 in Southern Louisiana; hydrogeologic studies were performed at Pleasant Gayou on the Texas Gulf Coast; hydrochemical studies for long-term flow of Pleasant Bayou geopressured geothermal well #2; and measurements were made on co-located heavy oil and geopressured geothermal brine resources in South Texas and Southern California. 79 refs., 154 figs., 13 tabs. (FSD)

1520 Geothermal Data and Theory

Refer also to citation(s) 42643, 42645

17 WIND ENERGY

1704 Economic, Industrial, and Business Aspects

42646 (RISO-M–2855) **Windpumps in Denmark: Status and development potentials.** Voelund, P. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Feb 1990. 68p. (In Danish). Order Number DE90509413. Source: NTIS (US Sales Only), PC A04/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

The technical development of the windpump, that has been going on internationally during the last decades is sketched with emphasis put on the development in the eighties. A status of the Danish work with windpumps, covering industry as well as public institutions and markets is given. Relevant technical development perspectives are described, and future sales possibilities for Danish windpumps are evaluated. The Danish windpumps, that are currently interesting, are described in more details. By means of measurements of yield from a windpump of the type Unimax P300 with a prototype-rotor of diameter 2.0m some obvious development possibilities are described. Construction of an optimized rotor is described, and a modification of the yawing at a roughness class 3 site in Denmark, at which the mean wind speed 6 meter above the ground level is 3.0 m/s, a mean yield of 0.38 m3/hour can be expected for the windpump in the original configuration with the prototype-rotor. With changed yawing system the measurement results corresponds to a mean yield of 0.66 m3/hour at the same site. Changing the rotor with the optimized rotor results in a increase in the measured yield corresponding to a mean yield of 1.09 m3/hour at the same site. (author) 27 ills., 5 refs.

1706 Wind Energy Engineering

Refer also to citation(s) 42646

42647 (ECN-C–90-019) **Results from a test of rotor blades with a passively controlled tip: Calibration and test under motor control.** Dekker, J.W.M.; De Groot, C.M.; Spaeth, M. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1990. 65p. Contract NOVEM 41.33-013.10. Order Number DE90509338. Source: NTIS (US Sales Only), PC A04/MF A01.

Under contract by the Netherlands Agency for Energy and the Environment (NOVEM) and the European Economic Community (EEC), rotor blades with a passively controlled rotor tip are under test at the test facility '25 m HAWT' of ECN, Petten. The general goal of the project as a whole is to support the development of a rotor equipped with a passively controlled rotor tip. This support will be given by testing and collecting experimental data from a prototype version, mounted on the rotor test facility '25 m HAWT' of ECN. The test as a whole is divided into four phases: 0. Preparatory work for the test on the rotor test facility; 1. Initial test at the rotor test facility in standstill or in motor operation; 2. Testing in normal operation, going step by step from lower (8 m/s) to higher wind speeds (20 m/s); 3. Long term testing, in continuous automatic operation, with special emphasis on wear and fatigue. The specific goal of phase 1 of the project is to check the functioning and the calibration procedure of the sensors by means of operational experience at standstill and in motor operation. Moreover, the results obtained under the above mentioned operational conditions, serve as a reference base for the interpretation of the measurements at normal operation as will be performed in phase 2 of the project. This report describes the results of phase 1. Phase 3 will be carried out with a slightly modified configuration with respect to phase 1 and phase 2. 49 figs., 6 refs., 8 tabs.

42648 (RISO-M–2826) **Measured airfoil characteristics of three blade segments on a 19 m HAWT rotor.** Aagaard Madsen, H. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1990. 22p. Contract EM-1364/88-3;Contract EN3W.0032-DK(B). Order Number DE90509411. Source: NTIS (US Sales Only), PC A03/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

EFP-88.

So far, a full understanding of the basic aerodynamics of HAWT rotor has lagged due to the spareness of detailed rotor force and flow measurements. The common measurements of overall rotor characteristics as e.g. rotor power and blade bending moments have indicated a different performance of an airfoil segment of a rotor blade when compared with its characteristics in a 2D steady flow. However, this type of measurements do not allow a thorough interpretation and analysis of the causes for these differences. Recently, this has initiated a few experimental research programs in

different countries with the objectives of providing much more detailed measurements of the airfoil characteristics, locally on a rotating blade. The most common way is to measure pressure profiles and integrating these to local forces but in the present research program, another approach has been used. A standard 8.2 m blade (NACA 63n - 2nn airfoil sections) manufactured by LM, Denmark, has been modified so that three 0.5 m span blade segments at 37%, 68% and 97% radius, respectively, are singly hinged on a three component balance, attached to the main spar of the blade. The relative inflow velocity vector to the blade (magnitude and angle of attack) is measured by a five hole pitot tube, mounted on the blade about on echord length in front of the leading edge. A detailed description of this experimental set-up is presented along with measured airfoil characteristics for the three blade segments, both for the blade rotating and for the blade in standstill in high wind conditions. On the basis of these data the influence of unsteady effects and of 3D flow effects on the airfoil characteristics of a HAWT blade is discussed. (author).

42649 (RISO-M–2835) **The impact of the induced velocity in the near flow field of a horizontal axis wind turbine.** Schmidt Paulsen, U. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Dec 1989. 89p. Order Number DE90512544. Source: NTIS (US Sales Only), PC A05/MF A01.

The report describes extensive power performance investigation on a Vestas V20 100 kW prototype wind turbine. The measurements carried out and reported here comprises the experimental and theoretical results on power performance and induced wind speed effects derived at different cup anemometer locations. The report reviews in a separate annex recent development of measurements and theoretical models of the flow. (author) 15 tabs., 37 ills., 32 refs.

42650 (STEV-VIND–90-10) **The wind power plant at Maglarp. Measurements and tests 1985-1988. Final report.** Magnusson, L. (Aeronautical Research Inst. of Sweden, Bromma (SE)). Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). Aug 1989. 53p. (In Swedish). Project STEV-506-260. (FFA-TN–1989-31). Order Number DE90512617. Source: NTIS (US Sales Only), PC A04/MF A01.

The project comprised extended measurements, a continued evaluation of the wind/power curve and loads and stresses under various operating conditions, different tests, and operation, maintenance and completion of the plant measuring system. Tests accomplished: operation of the plant after stepwise being turned out of the wind, operation with locked teeter function, and tests with rapid changes of the blade angle. In another test the blade swings were filmed under operation by means of a co-revolving video camera. The test results have contributed to important knowledge of the properties of the plant and provided a valuable basis for verification and development of models and methods within structural dynamics, aerodynamics and control technology. (25 figs., 1 tab., 26 refs.).

42651 (TUD-MEMT–5) **DUWECS reference guide V1.0: Delft University wind energy converter simulation program.** Bongers, P.M.M. Technische Hogeschool Delft (Netherlands). Faculteit der Werktuigbouwkunde en Maritieme Techniek. 1990. 78p. Grant CEC ENW3-0044-NL;Grant NOVEM 41.33-020.10. Order Number DE90509329. Source: NTIS (US Sales Only), PC A05/MF A01.

A description is given of the wind turbine simulation program DUWECS, which is designed during a research project on integrated dynamic models for flexible wind turbines. The program is divided into two parts: a program shell and a user defined wind turbine model. The wind turbine model consists of different modules. The modules are mutually interacting via user specified interaction variables. The user can modify each module and use it in the wind turbine model. An environment is created by which the user can easily exchange modules to be able to analyze the dynamic behavior of different wind turbines. The program shell is not user modifiable. The program uses dynamic memory allocation to minimize the necessary computer capacity. All manipulations performed in the program shell are pointer oriented. The DUWECS program is written in Fortran 77 with minor MS-Fortran extensions and is capable to run on MS-DOS computer systems. DUWECS version for other computer systems can be made available. The input to DUWECS can be given interactively or by means of files. The result of a DUWECS run is one or more files. These files can be read by standard programs. The MS-DOS version of DUWECS writes files that can be read directly by PC-MATLAB. 11 figs., 16 refs., 4 tabs., 4 apps.

42652 (TUD-MEMT–6) **An integrated dynamic model of a flexible wind turbine.** Bongers, P.; Bierbooms, W.; Dijkstra, S.; Van Holten, T. Technische Hogeschool Delft (Netherlands). Faculteit der Werktuigbouwkunde en Maritieme Techniek. 1990. 121p. Grant CEC ENW3-0044-NL;Grant NOVEM 41.33-020.10. Order Number DE90509330. Source: NTIS (US Sales Only), PC A06/MF A01.

The application of more flexible components in wind turbines opens the possibility to construct better cost effective wind turbines. For the design of control strategies an accurate knowledge of the dynamic behavior of the system is required. In order to study the dynamic behavior of flexible wind turbines a model has been developed. The different subsystems of the wind turbine are individually modelled with about the same degree of accuracy. The different models of the subsystems are coupled into one integrated dynamic model what is implemented as simulation code in the DUWECS program. The DUWECS program is developed in such a manner that it has become a user friendly and easy to handle tool for the study of the dynamic features of wind turbine systems. The possibilities of the developed DUWECS program are illustrated by various simulations of the wind turbine system under various conditions. The interaction effects on the overall behavior are shown, confirming the importance of an integrated dynamic model. The effects of the non-linear modelling of the rotor system are shown, what leads to the conclusion that for some more global applications the simpler rotor models may be sufficiently accurate. Based on the models quite a number of control techniques are designed and the results are presented. As an interesting application some simulations are shown with passive pitch control of the rotor system. The model is very easily to adapt to this quite different type of control strategy. The different simulations show clearly the flexibility of the DUWECS program for the possible different applications and the usefulness for the design of control strategies of wind turbines. 40 figs., 61 refs., 1 tab., 3 apps.

1707 Health and Safety

42653 (ECN-C–90-017) **Collection of data on accidents and incidents of wind turbines for updating of safety criteria.** Stam, W.J.; Schuurman, J.J.; Ramakers, S.G.M.; Roos, A.L. Netherlands Energy Research Foundation, Petten (Netherlands). May 1990. 91p. Contract CEC 86-B-7031-11-007.1-17;Project ECN 0377.01. Order Number DE90509315. Source: NTIS (US Sales Only), PC A05/MF A01.

In order to establish a firm basis to be used to arrive at recommendations for a safety philosophy, the CEC (DGXVII) has initiated a project to collect and process information on accidents and incidents with wind turbines. To fulfil the above mentioned objective the folowing activities were carried out: development and implementation of a data base computer system; creation of structurized incident reporting mechanisms in the individual participating member states. A straightforward and well-tested data base computer program operating in a dBase environment was developed and implemented on available personal computer systems at the participating institutes. Data from incident-questionnaires (developed in the previous project) can be stored with this INCIDENT program in a computer file. A general strategy was developed to structurize the data collection mechanisms. Also public-relation material was created. This strategy resulted in a quite adequate collection mechanisms in the Netherlands, and, to a lesser degree, in the UK. The prospects in Germany are promising. Data collection in Denmark is still difficult. The number of installed wind turbines in Greece and Belgium at this moment is too small to start a structurized incident data collection. The present status of the 'Accidents and Incidents'-project justifies a continuation of the project in order to arrive at a Central Community Data Bank Service, operated by the national test stations and other institutes of the CEC-member states. Eventually the information extracted from the data base will support the

implementation of high-quality reliable wind turbines in the CEC. 2 tabs., 1 ref., 6 apps.

20 FOSSIL-FUELED POWER PLANTS

2001 Power Plants and Power Generation

Refer also to citation(s) 42334, 42662, 42917, 42919, 43147

42654 (DOE/PC/79669–T2-App.) **MHD [magnetohydrodynamics] retrofit of a coal-fired generating plant: Appendices.** MHD Development Corp., Butte, MT (USA). 1989. 361p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79669. Order Number DE90008838. Source: NTIS, PC A16/MF A01 - OSTI.

This report presents the following appendices on the design of a coal-fired MHD retrofit: AVCO part load study; AVCO full load calculations; MSE mass balance calculations; Corette/MHD combined plant overall efficiency estimate; Corette boiler efficiency estimate; dynamic modeling and control simulation; combustor and nozzle scaling approach; field inductance and energy calculations; diagnostic instrumentation listing; equipment list; cost estimate factors; equipment and vendor costs data; CFFF test information; HRSR-ESP seed/ash calculations; and K_2/S molar ratio.

42655 (EPRI-GS–6905) **Use of circulating-fluidized-bed combustors in compressed-air energy storage systems: Final report.** Nakhamkin, M. (Energy Storage and Power Consultants, Mountainside, NJ (USA)); Patel, M. Electric Power Research Inst., Palo Alto, CA (USA); Energy Storage and Power Consultants, Mountainside, NJ (USA). ©Jul 1990. 139p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report presents the result of a study conducted by Energy Storage and Power Consultants (ESPC), with the objective to develop and analyze compressed air energy storage (CAES) power plant concepts which utilize coal-fired circulating fluidized bed combustors (CFBC) for heating air during generating periods. The use of a coal-fired CFBC unit for indirect heating of the compressed air, in lieu of the current turbomachinery combustors, would eliminate the need for expensive premium fuels by a CAES facility. The CAES plant generation heat rate is approximately one-half of that for a conventional steam condensing power plant. Therefore, the required CFBC heat generation capacity and capital costs would be lower per kW of power generation capacity. Three CAES/CFBC concepts were identified as the most promising, and were optimized using specifically developed computerized procedures. These concepts utilize various configurations of reheat turbomachinery trains specifically developed for CAES application as parts of the integrated CAES/CFBC plant concepts. The project team concluded that the optimized CAES/CFBC integrated plant concepts present a potentially attractive alternative to conventional steam generation power plants using CFBC or pulverized coal-fired boilers. A comparison of the results from the economic analysis performed on three concepts suggests that one of them (Concept 3) is the preferred concept. This concept has a two shaft turbomachinery train arrangement, and provides for load management functions by the compressor-electric motor train, and continuous base load operation of the turboexpander-electric generator train and the CFBC unit. 6 refs., 30 figs., 14 tabs.

42656 (LUTFD2-TFRT–5409-1-121-1989) **Gas turbine model for a combined cycle power plant.** Nilsson, J.; Fredriksson, H. Lund Univ. (Sweden). Dept. of Automatic Control. Sep 1989. 122p. (In Swedish). Order Number DE90512592. Source: NTIS (US Sales Only), PC A06/MF A01.

The subject of this work has been to examine the possibilities of modelling and computer simulation of a gas turbine for a combined cycle power plant. The work contains fundamental studies of the gas turbine, both as a detached plant and as a part of a combined cycle power plant. A suggestion for mathematical modelling has then been made. The conditions for the model is a single-shaft heavy-duty gas turbine, working at constant speed. From the proposed model has a program for computer simulation then been worked out. The program is the basis for simulation studies. To verify the model and its range of work, we have performed measurings at the gas turbine plant G25 at Oeresundsverket. The results of these measurings are presented in the work. A simplified model for stationary simulations of G25, based on the first program, has been developed. Computer simulation of the stationary operating behaviour has been performed. The results of the simulations are reasonable, considering the conditions. Dynamic simulation demands access to more detailed data. It is especially difficult to find the compressor and turbine characteristics that describes the relations between the pressure ratio, massflow, speed and efficiency for each component.

42657 (ORNL–6629/P1) **Evaluation of advanced austenitic alloys relative to alloy design criteria for steam service: Part 1, Lean stainless steels.** Swindeman, R.W.; Maziasz, P.J.; Bolling, E.; King, J.F. Oak Ridge National Lab., TN (USA). May 1990. 125p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE90014765. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The results are summarized for a 6-year activity on advanced austenitic stainless steels for heat recovery systems. Commercial, near-commercial, and developmental alloys were evaluated relative to criteria for metallurgical stability, fabricability, weldability, and mechanical strength. Fireside and steamside corrosion were also considered, but no test data were collected. Lean stainless steel alloys that were given special attention in the study were type 316 stainless steel, fine-grained type 347 stainless steel, 17-14CuMo stainless steel, Esshete 1250, Sumitomo ST3Cu® stainless steel, and a group of alloys identified as HT-UPS (high-temperature, ultrafine-precipitation strengthened) steels that were basically 14Cr–16Ni–Mo steels modified by various additions of MC-forming elements. It was found that, by solution treating the MC-forming alloys to temperatures above 1150°C and subsequently cold or warm working, excellent metallurgical stability and creep strength could be achieved. Test data to beyond 35,000 h were collected. The ability to clad the steels for improved fireside corrosion resistance was demonstrated. Weldability of the alloys was of concern, and hot cracking was found to be a problem in the HT-UPS alloys. By reducing the phosphorous content and selecting either CRE 16-8-2 stainless steel or alloy 556 filler metal, weldments were produced that had excellent strength and ductility. The major issues related to the development of the advanced alloys were identified and ways to resolve the issues suggested. 89 refs., 45 figs., 8 tabs.

42658 **ETEC cogeneration Power Pak.** Zweig, H.R. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.); Wieseneck, H.C.; Bunnell, J.W. *Proceedings of the American Power Conference (USA)*, 51: 490-494 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

As the result of a cooperative effort between government, industry, and a major utility, an important cogeneration project became operational in July, 1988. At the Energy Technology Engineering Center (ETEC), a research, development and testing installation operated for the United States Department of Energy (DOE), a 26.9 megawatt turbine-generator added to the SCTI facility in a bottoming-cycle configuration recovers energy from the waste steam produced in the testing steam generators. This paper reports on this project, called Power Pak, which originated in 1980 with proposals to DOE for funding of a cogeneration addition, and encouragement by DOE to evaluate and pursue this and other energy conservation measures. This article presents a narrative history of the development of this project with lessons learned.

42659 **Laser removal of sludge from steam generators.** Nachbar, H.D. To Dept. of Energy, Washington, DC (USA). USA Patent 4920994/A/. 1 May 1990. Filed date 12 Sep 1989. USA Patent Application 7-406,002. Int. Cl. B08B 7/00. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method of removing sludge from steam generator interior surfaces. It comprises: generating a source of coherent light energy being laser light; accessing the interior surfaces of the steam generator with a fiberoptic transmission pipe; transmitting the laser light into sid steam generator sludge surface through the fiberoptic transmission pipe; focusing the laser light from the fiberoptic transmission pipe onto the sludge surface; and vaporizing the sludge with the energy of the focused light.

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Refer also to citation(s) 42333, 42334, 42663

42660 (DOE/MC/24258–T6) **Testing of electrostatic agglomerator following sorbent injection: Quarterly technical progress report, [November 1988–January 1989].** Kumar, K.S. (Research-Cottrell, Inc., Somerville, NJ (USA)); Bannister, R.L.; Diehl, R.C. Research-Cottrell, Inc., Somerville, NJ (USA). [1989]. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-88MC24258. Order Number DE90014305. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this contract is to investigate the removal of SO_x and particulate matter from direct coal fired combustion gas streams at high temperature and high pressure conditions. This investigation is to be accomplished through a bench scale testing and evaluation program employing a sorbent injection technique for SO_x removal and the innovative particulate collection concept of particulate growth through electrostatic agglomeration followed by high efficiency mechanical collection. The process goal is to achieve control better than that required by 1979 New Source Performance Standards. 1 ref., 4 figs.

42661 (NEI-SE–59) **Cleaning of SO_2 and NO_x from flue gas at coal fired power plants using electron beam and corona field methods: A literature study.** Nilsson, O.; Eninger, J. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Industrial Electrotechnology. Sep 1989. 76p. (In Swedish). Order Number DE90512612. Source: NTIS (US Sales Only), PC A05/MF A01.

The electron beam and pulsed corona discharged methods for SO_2 and NO_x cleaning of flue gas are described. Cost and power demands for the methods are also noted. (43 refs.).

42662 Advanced particle control technologies for pressurized-bed combustion applications. Bossart, S.J. (USDOE Morgantown Energy Technology Center, WV (USA)). *Proceedings of the American Power Conference (USA),* 51: 70-80 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

The efficiency, economic, and environmental advantages of coal-fired, pressurized fluidized-bed combustion (PFBC) combined-cycle systems for power generation can be further enhanced by the incorporation of advanced high-temperature, high-pressure particle control technologies. Incorporation of advanced particle control technologies into PFBC combined-cycle systems using cyclone separators for particle control can increase plant efficiency, lower the cost-of-electricity, decrease gas turbine maintenance requirements, and eliminate the need for post-turbine particle control to meet new source performance standards for particle emissions. The ceramic cross-flow filter, ceramic candle filter, screenless granular-bed filter, and acoustic agglomeration are advanced particle control technologies being developed for PFBC applications under programs sponsored by the U.S. Department of Energy. This paper describes the status, recent test results, remaining technical issues, and planned development programs for these particle control technologies.

2005 Environmental Aspects

Refer also to citation(s) 42662, 43276

2006 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42658, 42859

42663 Electric-utility demand side programs: Resources for the 1990s. Hirst, E. (Oak Ridge National Lab., TN (USA). Energy Div.). *Proceedings of the American Power Conference (USA),* 51: 46-56 (1989). DOE Contract AC05-84OR21400. (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

The purpose of this paper is to suggest much larger and more active roles for electric utilities in acquiring energy-efficiency and load-management resources. Valuable utility actions include increased efforts to assess existing and new demand-side technologies; to test alternative ways to implement demand-side programs; to aggressively acquire energy and capacity resources through efficiency and load-management programs; to develop innovative pricing mechanisms to modify load shapes and levels and to encourage participation in utility programs; to work with governments to support efficiency standards for new buildings, appliances and other energy-using equipment; to integrate their planning for demand-side programs with planning for supply resources; and to incorporate the risk-reduction benefits of demand-side programs into their resource planning.

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Refer also to citation(s) 42540, 42541, 42542, 42748, 42762, 42770

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 42721, 42732, 42761, 42763, 42764, 42769, 42785, 42797, 42798, 42802, 42804, 42806

42664 (IAEA-TECDOC–550, pp. 535-543) **Simplified BWR performance and safety.** Rao, A.S. (General Electric Co., San Jose, CA (USA). Nuclear Energy Div.); Sawyer, C.D.; Huang, R.L.; Paradiso, F.M.; Townsend, H.E. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The design for the Simplified Boiling Water Reactor (SBWR) nuclear plant represents a complete conceptual design for a 600 MWe power plant. This paper provides a description of the SBWR including the passive safety design features and the thermal hydraulic analysis of their performance. The SBWR is a plant that is significantly simpler to build, operate and maintain compared to currently operating plants. The reason, for this simplification is inherent in some of the key features - elimination of the forced recirculation system, use of passive safety features and use of a direct cycle system. The use of passive safety systems has resulted in the elimination of all safety-grade pumps and diesel generators and has enabled significant simplification of the plant design. The major passive safety systems include a depressurization system/gravity driven cooling system to provide core cooling. An isolation condenser is used to remove decay heat for all transients and accidents. (author). 5 refs, 4 figs, 2 tabs.

42665 (KFK–4589) **Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.** Bahm, W. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. 169p. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The two expert groups of the Nuclear Society (KTG), 'chemistry and waste disposal' and 'fuel elements' discussed interdisciplinary problems concerning the development and reprocessing of advanced fuel elements. The 10 lectures deal with waste disposal, mechanical layout, operating behaviour, operating experiences and new developments of fuel elements for water moderated reactors as well as operational experiences of the Karlsruhe reprocessing plant (WAK) with reprocessing of high burnup LWR and MOX fuel elements, the distribution of fission products, the condition of the fission products during dissolution and with the effects of the higher burnup of fuel elements on the PUREX process. (DG).

42666 (KFK–4589 III.1-III.34) **Mechanical design and operating behaviour of advanced LWR fuel elements.** Gross, H.

(Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Fuchs, H.P.; Wunderlich, F.; Gaertner, M. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The development of fuel elements for pressurized and and boiling water reactors during the last years was marked by a reduction of the fuel cycle costs with security and reliability in operation remaining constant. The heightening of fuel discharge burnup and the improvement of neutron economy contributed essentially to that. The latter had been achieved by a reduction of the parasitic absorption within the fuel element and the leakage of neutrons of the reactor cores. These improvements could be obtained under complete observance of the safety-relevant requirements. Due to the change to fuel elements with a higher number of rods and correspondingly lower rod power it was even possible to raise the security margins partly. A survey of the state of experiences of Siemens/KWU is given. (orig./DG).

42667 (KFK–4589 VI.1-VI.10) **Development of new fuel elements by ABB.** Ehlers, K. (Asea Brown Boveri Reaktor GmbH, Mannheim (Germany, F.R.)); Vesterlund, G. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The improvement of operational safety and reduction of fuel cycle costs are the motivating forces in the development of new ABB fuel element concepts such as the SVEA concept in 1981. The SVEA 96/100 design opens up the possibility to improve the operational safety with a fuel coolant interaction proof fuel element and the possibility to increase the burnup. These aims also apply to PWR fuel elements. With the safety standard maintained, the introduction of solid Zircaloy spacers, the axial distribution of gadolinium and the development of a corrosion resistant fuel can, mainly economic aspects are concerned. (orig./HP).

42668 (KFK–4589 VIII.1-VIII.31) **Development and operating experience with new LWR fuel elements.** Sofer, G.A.; Blank, K.H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The Advanced Nuclear Fuels Corporation (ANF) supplies fuel elements and services for pressurized and boiling water reactors in Europe, the USA and the Far East. During the 19 years of its existence the ANF produced more than 16.300 fuel elements in the two manufacturing plants of Richland, USA and Lingen, FRG for 43 pressurized and boiling water reactors. In this context a series of innovations as regards the design of fuel cans, Zircaloy for spacers and Gd absorber in the fuel rod for the improvement of the operating behaviour of the elements was realized. (orig./DG).

42669 (NUREG–1425) **Welding and nondestructive examination issues at Seabrook Nuclear Station: An independent review team report.** Spessard, R.L.; Coley, J.; Crowley, W.; Walton, G. Nuclear Regulatory Commission, Washington, DC (USA). Office of the Executive Director for Operations. Jul 1990. 402p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A18/MF A01 - GPO; OSTI; INIS.

In response to congressional concerns about the adequacy of the welding and nondestructive examination (NDE) programs at the Seabrook Nuclear Station, NRC senior management established an independent review team (IRT) to conduct an assessment. The IRT focused on the quality of the finished hardware and associated records, as well as on the adequacy of the overall quality assurance program as applied to the fabrication and NDE programs for pipe welds. This report documents the findings of that investigation.

42670 Design certification of System 80 Plus. Davis, G.A. (Combustion Engineering, Inc., Windsor, CT (USA)); Kennedy, E.H. *Proceedings of the American Power Conference (USA),* 51: 679-687 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper reports on the design certification of an advanced light water reactor (ALWR) design, System 80 Plus. The advanced features of the System 80 Plus design, and its firm foundation in proven technology, are expected to meet utility needs for an improved, standardized nuclear power plant design. Design Certification by the Nuclear Regulatory Commission (NRC), is expected to provide regulatory stability.

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 42400, 42553, 42665, 42666, 42667, 42668, 42670, 42721, 42732, 42744, 42747, 42757, 42761, 42763, 42764, 42777, 42784, 42788, 42796, 42797, 42798, 42802, 42804, 42805, 42813

42671 (CDTN-DETR-PD–018/85) **An analysis of CDTN performance in the reactors technology area.** Pinheiro, R.B. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 7 May 1985. 23p. (In Portuguese). Order Number DE90635484. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The author makes an analysis of CDTN (Centro de Desenvolvimento da Tecnologia Nuclear) performance in the reactors technology area, showing difficulties and failures, but emphasizing the particular competence and capacity acquired in this area, as for example: the capacity in codes and methods are of neutronic calculations and nuclear projects, experimental thermohydraulic program, tests services in components and the others. (C.M.).

42672 (CDTN-DETS-PD–001/85) **Irradiation testing of segmented fuel rods in a nuclear power plant.** Gartner, M.; Terra, J.L.; Lameiras, F.S. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1985. 27p. Order Number DE90635485. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An irradiation test is planned to be performed in Angra-1 nuclear power plant to determine the operational behavior of $(Th,U)O_2$ fuel rods. 4 segmented test fuel rods and 1 full-lenght fuel rod containing (Th,approx. 5% U235)O_2 pellets shall be designed, licensed and fabricated for loading into a carrier fuel assembly and for irradiation in the nuclear power plant (as part of the second reload). (author).

42673 (CDTN-DETS-PD–012/85) **Upper nozzle welding development transfer of Angra 2/00 fuel element to F.E.C. (Fabrica de Elemento Combustivel).** Lorenzo, R.F. di; Almeida, R.C. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 26 Sep 1985. 118p. (In Portuguese). Order Number DE90635486. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The technology development of upper nozzle welding of Angra-2 Combustible element, done at CDTN (Centro de Desenvolvimento da Tecnologia Nuclear), this technology transfer to FEC (Fabrica de Elemento Combustivel), the welders training of FEC in nozzle welding, the radiographic control of nozzle welds and the FEC personnel training in this nozzle welds radiography are presented is this report. (C.M.).

42674 (CDTN-DETS-PD–019/82) **Development of fabrication process of upper nozzle BIBLIS type of PWR fuel element.**

Miranda, O.; Lorenzo, D.F.R. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 3 Sep 1982. 72p. (In Portuguese). Order Number DE90635487. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Process and parameters of milling and welding of a upper nozzle BIBLIS type prototype are presented. Milling process, cutting tools studies, production devices and inspection were developed and researched. (author).

42675 (DOE/ID–10289) **US Department of Energy Three Mile Island Research and Development Program 1989 annual report.** EG and G Idaho, Inc., Idaho Falls, ID (USA). Jul 1990. 39p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90014734. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Defueling of the Three Mile Island Unit 2 (TMI-2) reactor continued through 1989. This report summarizes that work and other TMI-2 related cleanup, research, and development activities. The major topics in this report include: waste immobilization, core debris transportation, receipt, and storage, accident evaluation program, and technical integration program. Significant progress was made toward completing the US Department of Energy (DOE) programmatic effort of support to cleanup the TMI-2 facility. Completion of this effort is expected during 1990. 5 figs., 2 tabs.

42676 (IAEA-TECDOC–550, pp. 239-253) **Fundamental trends in and technical measures for improving the safety of operating and planned WWERs.** Berkovich, V.M. (Ministry of Atomic Energy, Moscow (USSR). Atomehnergoproekt Inst.). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

This report covers certain issues related to the improvements in safety of Soviet NPPs with PWR reactors. The analysis is done for the modes of operation with significant deviation from normal operating conditions, such as blackout at NPPs; failure of all mechanical safety devices when they are required to function; significant leakages of primary circuit coolant into the secondary circuit; nonscheduled shutdown cooling of the reactor; loss of information about the state and condition of different components of the safety system. Some recommendations and proposals are given for modification in the systems of the NPP, including passive devices, which permit to reduce probability of exceeding the related radioactivity release by two orders of magnitude. (author). 5 figs, 4 tabs.

42677 (IAEA-TECDOC–550, pp. 361-371) **Improved containment concept for future PWRs.** Hennies, H.H. (Kernforschungszentrum Karlsruhe Gmbh (Germany, F.R.)); Kessler, G.; Eibl, J. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Improvements to PWR containment design are discussed which, at a moderate cost increase over present-day containments, would permit the deterministic exclusion of the catastrophic consequences of the most severe accidents such as core melt-through, steam explosion or hydrogen detonation. (author). 24 refs, 5 figs.

42678 (IAEA-TECDOC–550, pp. 387-399) **Enhanced safety district heating reactor unit.** Mitenkov, F.M. (Experimental Machine Building Design Bureau, Gorki (USSR)); Samoilov, O.B. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The main physical and technical features of the reactor units for nuclear district heating plants (NDHP) (space heating and hot water supply) are described. To ensure the NDHP safety, engineering decisions based on the inherent properties of the reactor self-protection and passive safety systems were required. It is shown that AST reactors for the plants under construction in the USSR meet the demands of enhanced safety concept. Radiological consequences of severe accidents near residential area (5 km, min. away from plant) are limited by the known fluctuation range of radioactivity background on the Earth (less than 10 mSv per accident). (author). 6 figs.

42679 (IAEA-TECDOC–550, pp. 401-413) **Safety and licensing of nuclear heating plants.** Snell, V.G. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Hilborn, J.W.; Lynch, G.F.; McAuley, S.J. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

World attention continues to focus on nuclear district heating, a low-cost energy from a non-polluting fuel. It offers long-term security for countries currently dependent on fossil fuels, and can reduce the burden of fossil fuel transportation on railways and roads. Current initiatives encompass large, centralized heating plants and small plants supplying individual institutions. The former are variants of their power reactor cousins but with enhanced safety features. The latter face the safety and licensing challenges of urban siting and remotely-monitored operation, through use of intrinsic safety features such as passive decay heat removal, low-stored energy and limited reactivity speed and depth in the control systems. Small heating reactor designs are compared, and the features of the SLOWPOKE Energy System, which is in the forefront of these, are summarized. The challenge of public perception must be met by clearly presenting the characteristics of small heating reactors in terms of scale and transport safety in design and operation, and by explaining the local benefits. (author). 23 refs, 2 figs, 1 tab.

42680 (IAEA-TECDOC–550, pp. 493-503) **The PIUS nuclear power reactor: A possible answer to the greenhouse effect.** Hannerz, K. (ABB Atom AB, Vaesteraas (Sweden)); Pind, C. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The new awareness of the environmental effects of fossil fuel burning on the earths climate through the greenhouse effect, should make the nuclear option more attractive in a world hungry for energy. In the last few years new designs have emerged of nuclear reactors with improved safety that should make them more acceptable to the public, thereby diverging the energy option from

a question of choosing between plague (coalburning) and cholera (nuclear power perceived as hazardous). ABB Atom has in the last decade developed the PIUS reactor with outstanding, clearly understandable safety features imbedded in the hydraulic principle. By simple laws of nature the reactor core is protected against overpower, loss of coolant, human mistake and mischief and other plausible events. In any such events the core is brought to a shutdown state and cooled without use of active components or actions from plant personnel. The paper briefly describes the design of the PIUS reactor and shows its unique safety aspects, compared to other LWRs. Economic studies have shown that the revolutionary safety performance can be obtained without economic sacrifice. The ultimate target is to start operation of a 600 MWe lead plant before the end of the century. (author). 3 refs, 4 figs, 1 tab.

42681 (IAEA-TECDOC–550, pp. 589-602) **The safe integral reactor: Development for the next generation.** Hayns, M.R. (UKAEA Harwell Lab. (UK)); Jones, T.A.; Teare, K.R.; Bradbury, R. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

For any reactor to stand a chance of being accepted as a realistic contender for deployment as a next generation plant it must embody features such as simplicity, robustness against maloperation, economy in construction and operation and demonstrably reduced potential for environmental impact. By taking a fresh look at PWR design, a consortium of Combustion Engineering and Stone and Webster in the US, and Rolls-Royce and Associates and the AEA in the UK have come up with a design which is intended to satisfy these requirements. This paper describes the detailed design of the Safe Integral Reactor (SIR). It highlights the special features which make this design innovative, yet based firmly in established technology, economically viable when compared to large "current designs" and strategically attractive to utilities because of its small size, ease of construction and short construction time. The design features highlighted are: an integral pressure vessel containing core, steam generators, pressurizer and pumps; boron free operation; robustness against transients; no large LOCA; simple pressure suppression containment; no requirement for active decay heat removal systems. The practical attractiveness to utilities is emphasised by presenting an outline of both single and twin reactor layouts which offer great flexibility in deployment. (author). 3 refs, 5 figs, 2 tabs.

42682 (IAEA-TECDOC–550, pp. 603-609) **Safety and simplicity in a new era of nuclear plant design.** Bruschi, H.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Energy Systems Business Unit). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Westinghouse is designing the AP600 (Advanced Passive 600 MWe) as part of a cooperative program by the United States Department of Energy (DOE) and the Electric Power Research Institute (EPRI) to develop innovative light water reactors. Emphasizing passive safety system in the design for future nuclear power plants improves safety, operability and economics which are paramount in obtaining greater acceptability with the public. In addition, modular construction techniques permit further improvements in construction, schedule and costs. This paper describes the impact of emphasis on passive safety systems, modularization and the resultant overall plant simplicity. Simplicity applied to construction methods has led to the use of transportable modules manufactured at a central, remote facility - gaining higher quality from a permanent cadre of skilled labor. Use of transportable modules offers both quality and safety advantages in constructing this plant, not only in countries with advanced development, but also in areas of the world which have fewer skilled workers and many unskilled construction workers. This advanced digital instrumentation and control system and Advanced Control Room further simplify operation and allow more efficient operator action during both normal and abnormal operation. (author). 5 figs, 1 tab.

42683 (IAEA-TECDOC–550, pp. 621-634) **LOBI-MOD2 results relevant to passive safety feature of prospected PWRs.** Addabbo, C. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Annunziato, A.; Leva, G.; Wampach, R. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Salient results from LOBI-MOD2 tests emphasizing phenomenologies relevant to passive safety features of prospected power reactors are outlined. Specific reference is made to the mitigation of postulated accident consequences using deliberate primary coolant system depressurization and passive safety injection from the accumulator injection system. Although test conditions are strictly pertinent to pressurized water reactors of current design, the underlying phenomenologies are nevertheless of general interest also for next generation reactor concepts. (author). 5 refs, 13 figs.

42684 (SIEMENS-KWU-B–413/90/6) **Test of recycled uranium in the Obrigheim NPP. Final report.** Goll, W.; Porsch, D.; Schlemmer, F.; Jorde, D.; Braun, U. Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Feb 1990. 72p. (In German). Contract BMFT AtT 7692/3. Order Number DE90510178. Source: NTIS (US Sales Only), PC A04/MF A01.

Operasting performance and isotopic composition were analyzed for UO_2-fuel from enriched reprocessed uranium (ERU) by performing post-irradiation examinations at burnups of up to 46 GWd/t(U). The examinations confirm a similar operating performance of fuel rods with ERU-fuel and with conventional standard UO_2-fuel. The comparison of neutron physics results with the isotopic analyses confirm that the fuel rod power histories and thus the reactivity can be predicted with sufficient accuracy. The build-up of nuclides relevant to neutron physics is described with sufficient accuracy, too. (orig.) With 11 refs., 28 figs., 11 tabs.

42685 (SV-UK–1989-43) **Steam side droplet erosion of titanium condensors.** Bodlund, G. Swedish State Power Board, Vaellingby (Sweden). 20 Dec 1989. 61p. (In Swedish). Order Number DE90512597. Source: NTIS (US Sales Only), PC A04/MF A01.

Damages on steamside of condensor tubes caused by erosion and pores, in some cases followed by salt water leakages, have been noted. Production data has been collected to evaluate condensor load. Droplet velocities have been calculated from steam velocities and geometries to consider realistic mechanisms for damages and to compare the risks between different stations. Metallurgical studies and erosion tests have been performed.

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Refer also to citation(s) 42766, 42767, 42773, 42774, 42944, 42947, 42948, 42949, 42950, 43260

42686 (IAEA-TECDOC–550, pp. 611-620) **Inherent safe heat removal in advanced medium-sized high-temperature reactors.**

Kugeler, K. (Duisburg Univ. (Germany, F.R.). Inst. for Energy Technology); Philippen, P.W.; Schmidtlein, P.; Swatoch, R. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

One of the main points for the inherent safety of a pebble bed high temperature reactor (HTR) is to guarantee the safe removal of the after-heat in case of a break-down of all active cooling systems like heat-exchangers or liner-cooling. This will be necessary because it is well known today that graphite pebble bed fuel elements stay intact, if the accident temperature is below 1600 deg. C. Therefore the heat must be taken out of the reactor system by passive, natural law heat-transfer mechanism so that the maximum fuel temperature stays below the specified limit. Today medium-sized HTRs with a power of 750 MW_{th} and more (TGTR-300, HTR 500) reach temperatures of more than 2400 deg. C in small parts of the core in such hypothetical accidents. A possible way to realize the inherent safe heat removal in advanced medium-sized HTRs is to change the form of the core. Instead of employing the standard cylindrical geometry a plate shaped core should be preferred, described by the proportion of width to depth of approx. 6:1, causing short distances for heat transfer to the side reflectors within the core and due to the reduction of the mean core power density less than 3 MW/m^3. A further improvement of the passive heat removal in case of a failure of the liner-cooling can be achieved by adding cast iron and/or metal granulated material to the concrete of the reactor vessel increasing the thermal conductivity. In case of a total failure of the liner-cooling, heat removal within the prestressed concrete vessel is also possible using installed vertical ducts which make it possible that fresh air runs through the ducts by natural convection cooling the reactor vessel. Even the total removal of the after-heat is possible by suitable arrangement, number and shape of such ducts. (author). 4 refs, 11 figs, 1 tab.

42687 (IWGGCR–18) **High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.** International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. 214p. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The Specialists' Meeting was organized in conjunction with an earlier meeting on this topic held in Vienna, Austria, 1981, which provided for a comprehensive review of the status of materials development and testing at that time and for a description of test facilities. This meeting provided an opportunity (1) to review and discuss the progress made since 1981 in the development, testing and qualification of high temperature metallic materials, (2) to critically assess results achieved, and (3) to give directions for future research and development programmes. In particular, the meeting provided a form for a close interaction between component designers and materials specialists. The meeting was attended by 48 participants from France, People's Republic of China, Federal Republic of Germany, Japan, Poland, Switzerland, United Kingdom, USSR and USA presenting 22 papers. The technical part of the meeting was subdivided into four technical sessions: Components Design and Testing - Implications for Materials (4 papers); Microstructure and Environmental Compatibility (4 papers); Mechanical Properties (9 papers); New Alloys and Developments (6 papers). At the end of the meeting a round table discussion was organized in order to summarize the meeting and to make recommendations for future activities. This volume contains all papers presented at the meeting. A separate abstract was prepared for each of these papers. Refs, figs and tabs.

42688 (IWGGCR–18, pp. 15-27) **Service conditions and relevant properties of HTGR metallic materials.** Bodmann, E. (Hochtemperatur-Reaktorbau GmbH, Mannheim (Germany, F.R.)); Diehl, H.; Blume-Firla, I.; Demus, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

Primary coolant temperatures in an HTGR lie between 250 and 1000 deg. C. Special requirements for HTGR components, and hence materials have arisen, because of the temperatures, the properties of the coolant and neutron irradiation in regions adjacent to the core, coupled with the nuclear quality and safety codes. Typical major metallic components are steam generators, helium/helium heat exchangers, steam reformers and control and shut down rods. The operational conditions for these components are given. The present status of the knowledge of the data for the most important material properties for component layout is described. (author). 13 figs, 11 tabs.

42689 (IWGGCR–18, pp. 28-34) **A proposal to develop a high temperature structural design guideline for HTGR components.** Hada, K. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). HTTR Designing Lab.). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

This paper presents some proposals for developing a high-temperature structural design guideline for HTGR structural components. It is appropriate that a basis for developing high-temperature structural design rules is rested on well-established elevated-temperature design guidelines, if the same failure modes are expected for high-temperature components as considered in such design guidelines. As for the applicability of ASME B and PV Code Case N-47 to structural design rules for high-temperature components (service temperatures $\geq$ 900 deg. C), the following critical issues on material properties and service life evaluation rules have been pointed out. (i) no work-hardening of stress-strain curves at high temperatures due to dynamic recrystallization; (ii) issues relating to very significant creep; (iii) ductility loss after long-term ageing at high temperatures; (iv) validity of life-fraction rule (Robinson-Taira rule) as creep-fatigue damage evaluation rule. Furthermore, the validity of design margins of elevated-temperature structural design guidelines to high-temperature design rules should be clarified. Solutions and proposals to these issues are presented in this paper. Concerning no work-hardening due to dynamic recrystallization, it is shown that viscous effects cannot be neglected even at high extension rate for tensile tests, and that changes in viscous deformation rates by dynamic recrystallization should be taken into account. The extension rate for tensile tests is proposed to change at high temperatures. The solutions and proposals to the above-mentioned issues lead to the conclusion that the design methodologies of N-47 are basically applicable to the high-temperature structural design guideline for HTGR structural components in service at about 900 deg. C. (author). 9 refs, 5 figs.

42690 (IWGGCR–18, pp. 34-42) **Design requirements for high temperature metallic component materials in the US modular HTGR.** Shenoy, A.S. (General Atomics, San Diego, CA (USA)); Betts, W.S. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. Contract DE-AC03-88SF17367. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.*

Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The modular high temperature gas-cooled reactor (MHTGR) is a 350 MW(t) second generation reactor system design which during normal operation circulates helium with a mixed mean cold and hot temperature of 260 deg. C (500 deg. F) and 690 deg. C (1270 deg. F), respectively. The design incorporates passive design features which allow the plant to be safely shutdown and cooled with no active systems or operator action being required. A key feature of this concept is the capability of the residual heat removal by passive conduction cooldown from the core to the reactor cavity via an uninsulated vessel. The MHTGR uses a number of metallic components. A description of these components and their design requirements are presented in this paper. (author). 3 refs, 7 figs, 4 tabs.

42691 (IWGGCR–18, pp. 42-49) **Structural integrity evaluation of a helically-coiled He/He intermediate heat exchanger.** Okubo, M. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). HTTR Designing Lab.); Hada, K.; Baba, O. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

This paper presents structural integrity evaluation results for the heat transfer tubes, central hot gas duct, and hot header of the intermediate heat exchanger (IHX) of the High-Temperature Engineering Test Reactor (HTTR) under design in JAERI. Thermal transients and boundary conditions for the evaluation were defined through plant dynamic analyses. On the basis of the evaluation results, requirements for a high-temperature metallic material for the HTTR are discussed. It is revealed in this paper that origins of the thermal stresses are different among the structures. As for the heat transfer tubes, the thermal expansion stress is dominant, and the thermal stress due to temperature gradient across the wall is not so high. Of the central hot gas duct, the reducer (tapered pipe) is the most critical part. The thermal binding stress due to temperature gradient along the reducer is dominant. In the hot header, the highest thermal stress occurs at the boundary area separating the manifold (perforated pipe) and the rim. For these high-temperature structures, elastically-calculated stresses and strains cannot satisfy the design limits because no relaxations of thermal stresses are assumed. Therefore, an inelastic (elastic+creep without plasticity)-calculation-based evaluation is required. This paper presents the inelastic-calculation-based evaluation results for the above-mentioned high-temperature structures. Finally, requirements for the heat-resistant alloy are discussed on the basis of the evaluation results. Since environmental effects on material properties become remarkable at high temperatures, such material properties data have been accumulated in test environments of both air and HTTR coolant-simulated helium gas, so-called JAERI-B He gas, by JAERI and other organizations. 1 ref., 6 figs, 3 tabs.

42692 (IWGGCR–18, pp. 53) **Structural instabilities of high temperature alloys and their use in advanced high temperature gas cooled reactors.** Schuster, H. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Ennis, P.J.; Nickel, H.; Czyrska-Filemonowicz, A. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

High-temperature, iron-nickel and nickel based alloys are the candidate heat exchanger materials for advanced high temperature gas-cooled reactors supplying process heat for coal gasification, where operation temperatures can reach 850-950 deg. C and service lives of more than 100,000 h are necessary. In the present paper, typical examples of structural changes which occur in two representative alloys (Alloy 800 H, Fe-32Ni-20Cr and Alloy 617, Ni-22Cr-12Co-9Mo-1Al) during high temperature exposure will be given and the effects on the creep rupture properties discussed. At service temperatures, precipitation of carbides occurs which has a significant effect on the creep behaviour, especially in the early stages of creep when the precipitate particles are very fine. During coarsening of the carbides, carbides at grain boundaries restrict grain boundary sliding which retards the development of creep damage. In the service environments, enhanced carbide precipitation may occur due to the ingress of carbon from the environment (carburization). Although the creep rate is not adversely affected, the ductility of the carburized material at low and intermediate temperatures is very low. During simulated service exposures, the formation of surface corrosion scales, the precipitation of carbides and the formation of internal oxides below the surface leads to depletion of the matrix in the alloying elements involved in the corrosion processes. In thin-walled tubes the depletion of Cr due to Cr_2O_3 formation on the surface can lead to a loss of creep strength. An additional depletion effect resulting from environmental-metal reactions is the loss of carbon (decarburization) which may occur in specific environments. The compositions of the cooling gases which decarburize the material have been determined; they are to be avoided during reactor operation.

42693 (IWGGCR–18, pp. 54-65) **Correlation between microstructure and the creep behaviour at high temperature of Alloy 800 H.** Spiradek, K. (Institute of Nuclear Physics, Cracow (Poland)); Degischer, H.P.; Lahodny, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

A systematic metallographic study was performed to identify the nature of the microstructural changes occurring during high temperature creep deformation of Alloy 800 H. Creep tests were carried out at 800 deg. C under constant load conditions corresponding to the initial stresses between 25 and 80 MPa. Some tests were interrupted after certain elongations to provide the samples for electron microscopy. Emphasis was put on the creep periods relevant to design where only a few per cent of deformation are tolerable. The influence of the initial material conditions on the creep behaviour was examined. Variations of the initial microstructures were achieved by different solution treatments (980/1250) deg. C, preageing at 800 deg. C (0/6400) h and cold deformation up to 10% followed by ageing at 800 deg. C. The results of the microstructural examinations were correlated with the creep curves that provide a basis for identification of the creep mechanisms operating at the test conditions. (author). 14 refs, 17 figs.

42694 (IWGGCR–18, pp. 72-77) **Corrosion behaviour of high temperature alloys in the cooling gas of high temperature reactors.** Quadakkers, W.J. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Schuster, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The reactive impurities in the primary cooling helium of advanced high temperature gas cooled reactors (HTGR) can cause oxidation, carburization or decarburization of the heat exchanging metallic components. By studies of the fundamental aspects of the corrosion mechanisms it became possible to define operating conditions under which the metallic construction materials show, from the viewpoint of technical application, acceptable corrosion behaviour. By extensive test programmes with exposure times of up to 30,000

hours, a data base has been obtained which allows a reliable extrapolation of the corrosion effects up to the envisaged service lives of the heat exchanging components. (author). 6 refs, 7 figs.

42695 (IWGGCR–18, pp. 81-90) **Current status of studies on high temperature metallic materials for HTGR applications in JAERI.** Tsuji, H. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Dept. of Fuels and Materials Research); Nakajima, H.; Kondo, T. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

Progress made in the studies on high-temperature metallic materials for HTGR applications in JAERI conducted during the last several years is reviewed, and future direction of the studies is also mentioned. The items of research activities carried out are classified into three different categories, i.e. those for the near-term target structural alloys, for the long-term target heavy duty structural alloys and for the cladding material for the neutron absorber rods. As for near-term target alloys for applications in the High-Temperature Engineering Test Reactor (HTTR), comprehensive qualification tests such as creep, fatigue, corrosion resistance and other fracture-relevant properties on Hastelloy XR which is a modified version of Hastelloy X have been carried out to accumulate the data for structural design and safety evaluation. For further improvement of the performance and optimization of the specification of Hastelloy XR, a creep resistant version with control of boron content with 40 to 70 ppm has also been developed. Significance of the impurity content in the helium environment on creep behaviour is highlighted. The development of new heavy duty Ni-Cr-W superalloys as the next generation candidates has been promoted for extended use at service temperatures up to 1,000 deg. C, the basal composition of the experimental alloys had been already specified. The investigation on the effects of minor elements such as C, Nb, Fe, Mn, Si, Ti, B and Y is underway to determine the optimized chemical composition of selected candidate alloys. For the selection of cladding materials for neutron absorber rods of HTTR, the post-irradiation tensile and creep tests have been performed, and Alloy 800H has been tested as one of the currently most realistic candidate materials. (author). 18 refs, 18 figs, 4 tabs.

42696 (IWGGCR–18, pp. 91-95) **High temperature low-cycle fatigue strength of Hastelloy-XR.** Nagato, K. (Kawasaki Heavy Industries Ltd, Tokyo (Japan). Nuclear Systems Div.); Murakami, T.; Hashimoto, T. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

This paper describes the low-cycle fatigue and creep-fatigue interaction properties of Hastelloy-XR in air and helium containing a small quantity of impurity gas. All tests at temperatures of 700, 800, 900 and 1000 deg. C are carried out at the strain rate of 0.1 and 0.01%/sec under the control of axial strain. Wave forms are triangular for continuous cycling tests and trapezoidal for tension hold time tests. The test results are compared with the fatigue property of Hastelloy-X which is the original alloy of Hastelloy-XR. The applicability of linear damage rule in ASME Code Case N-47 is discussed about creep-fatigue interaction property of Hastelloy-XR in High Temperature Gas-Cooled Reactor's temperature region. (author). 6 refs, 7 figs, 2 tabs.

42697 (IWGGCR–18, pp. 96-104) **Evaluation of mechanical properties of the alloy NiCr22Co12Mo (Alloy 617) for heat exchanging components of HTGRs.** Breitling, H. (Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Dietz, W.; Penkalla, H.J. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The HTR-materials program in Germany has been directed towards the qualification of high temperature alloys for heat exchanging components of advanced nuclear process heat plants. From the available conventional alloys, the nickel-base alloy NiCr22Co12Mo (Alloy 617) has been selected for the highest working temperatures. With respect to the design of intermediate heat exchanger and methane reformer tubes long term properties for different semifinished products and weldments of this material have been determined. The experimental work included creep and creep rupture tests, fatigue and creep/fatigue tests and short term mechanical tests after thermal ageing. With regard to the development of fracture mechanics criteria for leak before break argumentations, additional creep and fatigue crack growth experiments have been carried out. Typical examples of the data obtained will be presented. The implementation of the data in the derivation of design curves and the formulation of design rules will be shown. (author). 17 figs, 1 tab.

42698 (IWGGCR–18, pp. 129-135) **Post-service examination of a 10 MW helium-helium heat exchanger and comparison with long term behaviour in laboratory tests.** Cook, R.H. (R.M. Detection Ltd, Poole, Dorset (UK). High Temperature Materials Programme (HTMP)); Graham, L.W.; Exner, R. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

As part of the component test programme of the PNP Project, a 10 MW Helium/Helium heat exchanger (URKO: U-Rohr-Kompact Waermetauscher) designed and fabricated by Balcke-Duerr AG has been tested in the Komponentenversuchskreislauf (KVK) test facility at Interatom. The test run lasted for several months with a significant proportion of the operation being conducted at or near the peak design temperature of 950 deg. C. Following the test the heat exchanger was subjected to an examination to investigate the effects of the exposure and to determine the residual life of the key components. The present paper is concerned with the destructive examination being performed on the heat exchanger tubes at High Temperature Materials Programme (HTMP). The results so far obtained indicate that the exposure caused no damage to the tubes, the effects observed being within the range established in laboratory exposures previously carried out on specimens of several heats of the nickel base alloy, DIN 2.4663 used in the construction of the heat exchanger. (author). 2 refs, 14 figs, 2 tabs.

42699 (IWGGCR–18, pp. 159-168) **The new alloy Thermon 4972 (NiCr22W12Fe) for high temperature components of gas-cooled reactors.** Huchtemann, B. (Thyssen Edelstahlwerke AG, Krefeld (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

A new heat resistant Fe-Ni-Cr-W alloy - Thermon 4972 - was developed within the scope of the prototype nuclear process plant project. This new alloy not only shows mechanical properties and creep rupture properties similar to those of the nickel-based alloy Inconel 617 but in addition, the new alloy forms protective oxide layers in atmospheres with very low O_2 partial pressures. Experimental test results carried out in so called PNP-helium for durations up to 2000 h in the temperature range of 750 and 950

deg. C are compared with those of the alloy Inconel 617. Furthermore the mechanical properties of these two alloys as also the alloys Hastelloy X and Incoloy 800 H have been compared. (author). 5 refs, 18 figs, 2 tabs.

42700 (IWGGCR–18, pp. 182-189) **Experimental and theoretical work for the analysis of creep ratcheting and creep buckling of HTR components.** Breitbach, G. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Schubert, F.; Nickel, H.; Seehafer, H.J. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

At very high temperatures loaded metallic structures undergo inelastic deformations due to creep. The generated creep strains are connected with stress relaxations, stress redistributions and/or progressive deformations. The superposition of primary and secondary stresses may lead to enhanced creep deformations. This phenomenon is known under the name "creep ratcheting". The interchange of elastic and creep strains is important for its understanding. Theoretical and experimental work is discussed in this paper. In mainly load controlled situations the behaviour of the material can be described by a nonlinear viscous flow law (Norton power law), where elastic effects can be neglected. The creep collapse of a tube is an example of such a slow flow process. Theoretical calculations based on Hoff's model and on Finite Element Analysis are compared with experimental results. (author). 8 refs, 11 figs, 3 tabs.

42701 (IWGGCR–18, pp. 196-200) **Wear stresses in ceramic layers at elevated temperatures under helium atmosphere.** Fricker, U. (Sulzer Bros. Ltd., Winterthur (Switzerland)); Ullrich, G.; Alder, H.P. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

Within the frame of the PNP-project (Project of Nuclear Process Heat) in which the aim is the gasification of coal, an intermediate heat exchanger is planned in which the heat produced in a helium cooled graphite core of a high temperature reactor is usefully extracted to a secondary circuit which is impured with CH_4, H_2, CO, CO_2, N_2 and H_2O. In spite of a helix construction of the intermediate heat exchanger there are sliding fits during thermal extension. In order to avoid welding at elevated temperatures up to 1223 K (950 deg. C) and wear due to friction under helium atmospheres the surfaces are protected by layers. The long term stability, adhesive strength, and indifferent thermal expansion in the compound is unknown. For this case a mock-up of a heat exchanger (bundle of 18 tubes) with the possibility of an axial shift of the tubes and an additional vibrational excitation for simplex, duplex and triplex layers in different compositions were tested under helium. First results obtained under vibrational and static conditions are compared and discussed. (author). 6 figs, 1 tab.

42702 (IWGGCR–18, pp. 201-210) **Promising materials for HTGR high temperature heat exchangers.** Kuznetsov, E.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Tekhnologii Mashinostroeniya, Moscow (USSR)); Tokareva, T.B.; Ryabchenkov, A.V.; Novichkova, O.V.; Starostin, Yu.D. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The service conditions for high-temperature heat-exchangers with helium coolant of HTGRs and requirements imposed on materials for their production are discussed. The choice of nickel-base alloys with solid-solution hardening for long-term service at high temperatures is grounded. Results of study on properties and structure of types Ni-25Cr-5W-5Mo and Ni-20Cr-20W alloy in the temperature range of 900 deg. - 1,000 deg. C are given. The ageing of Ni-25Cr-5W-5Mo alloy at 900 deg. - 950 deg. C results in decreased corrosion-mechanical properties and is caused by the change of structural metal stability. Alloy with 20% tungsten retains a high stability of both structure and properties after prolonged exposure in helium at above temperatures. The alloy has also increased resistance to delayed fracture and low-cycle fatigue at high temperatures. The developed alloy of type Ni-20Cr-20W with microalloying is recommended for production of tubes for HTGR high-temperature heat-exchangers with helium coolant. (author). 3 refs, 8 figs.

2104 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated

Refer also to citation(s) 42739, 42756

42703 (IAEA-TECDOC–550, pp. 373-385) **Safety aspects of the CANDU man-machine interface.** Olmstead, R.A. (Atomic Energy of Canada Ltd, Mississauga, ON (Canada). CANDU Operations). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

There have been significant improvements in the man/machine interface in CANDU stations over the past three decades. The continuing rapid technological developments in computers and electronics, coupled with an increasing understanding and application of human factors principles is leading to further enhancements. This paper outlines progress to date and trends for future stations. (author). 13 refs, 5 figs.

42704 (IAEA-TECDOC–550, pp. 545-560) **Passive safety features for next generation CANDU power plants.** Natalizio, A. (Atomic Energy of Canada Ltd, Mississauga, ON (Canada). CANDU Operations); Hart, R.S.; Soedijono, P.; Dick, J.E.; Lipsett, J.J. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

CANDU offers an evolutionary approach to simpler and safer reactors. The CANDU 3, an advanced CANDU, currently in the detailed design stage, offers significant improvements in the areas of safety, design simplicity, constructibility, operability, maintainability, schedule and cost. These are being accomplished by retaining all of the well known CANDU benefits, and by relying on the use of proven components and technologies. A major safety benefit of CANDU is the moderator system which is separate from the coolant. The presence of a cold moderator reduces the consequences arising from a LOCA or loss of heat sink event. In existing CANDU plants even the severe accident - LOCA with failure of the emergency core cooling system - is a design basis event. Further advances toward a simpler and more passively safe reactor will be made using the same evolutionary approach. Building on the strength of the moderator system to mitigate against severe accidents, a passive moderator cooling system, depending only on the

law of gravity to perform its function, will be the next step of development. AECL is currently investigating a number of other features that could be incorporated in future evolutionary CANDU designs to enhance protection against accidents, and to limit off-site consequences to an acceptable level, for even the worst event. The additional features being investigated include passive decay heat removal from the heat transport system, a simpler emergency core cooling system and a containment pressure suppression/venting capability for beyond design basis events. Central to these passive decay heat removal schemes is the availability of a short-term heat sink to provide a decay heat removal capability of at least three days, without any station services. Preliminary results from these investigations confirm the feasibility of these schemes. (author). 4 refs, 11 figs, 3 tabs.

42705 (LA-UR–90-2357) **Proof-of-principle measurements for an NDA-based core discharge monitor.** Halbig, J.K. (Los Alamos National Lab., NM (USA)); Monticone, A.C. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–45: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014927. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The feasibility of using nondestructive assay instruments as a core discharge monitor for CANDU reactors was investigated at the Ontario Hydro Bruce Nuclear Generating Station A, Unit 3, in Ontario, Canada. The measurements were made to determine if radiation signatures from discharged irradiated fuel could be measured unambiguously and used to count the number of fuel pushes from a reactor face. Detectors using the (γ,n) reaction thresholds of beryllium and deuterium collected the data, but data from shielded and unshielded ion chambers were collected as well. The detectors were placed on a fueling trolley that carried the fueling machine between the reactors and the central service area. A microprocessor-based electronics system (the GRAND-I, which also resided on the trolley) provided detector biases and preamplifier power and acquired and transferred the data. It was connected by an RS-232 serial link to a lap-top computer adjacent to the fueling control console in the main-reactor control room. The lap-top computer collected and archived the data on a 3.5-in. floppy disk. The results clearly showed such an approach to be a adaptable as a core discharge monitor. 4 refs., 8 figs.

42706 (LA-UR–90-2405) **The design and installation of a core discharge monitor for CANDU-type reactors.** Halbig, J.K. (Los Alamos National Lab., NM (USA)); Monticone, A.C.; Ksiezak, L.; Smiltnieks, V. Los Alamos National Lab., NM (USA). [1990]. 8p. DOE Contract W-7405-ENG-36. (CONF-9007106–41: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014909. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A new type of surveillance systems that monitors neutron and gamma radiation in a reactor containment is being installed at the Ontario Hydro Darlington Nuclear Generating Station A, Unit 2. Unlike video or film surveillance that monitors mechanical motion, this system measures fuel-specific radiation emanating from irradiated fuel as it is pushed from the core of CANDU-type reactors. Proof-of-principle measurements have been carried out at Bruce Nuclear Generating Station A, Unit 3. The system uses (γ,n) threshold detectors and ionization detectors. A microprocessor-based electronics package, GRAND-II (Gamma Ray and Neutron Detector electronics package), provides detector bias, preamplifier power, and signal processing. Firmware in the GRAND-2 controls the surveillance activities, including data acquisition and a level of detector authentication, and it handles authenticated communication with a central data logging computer. Data from the GRAND-II are transferred to an MS-DOS-compatible computer and stored. These data are collected and reviewed for fuel-specific radiation signatures from the primary detector and proper ratios of signals from secondary detectors. 5 figs.

42707 (ORNL/TM–11513) **Two-dimensional DORT discrete ordinates X-Y geometry neutron flux calculations for the Halden Heavy Boiling Water Reactor core configurations.** Slater, C.O. Oak Ridge National Lab., TN (USA). Jul 1990. 521p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90014793. Source: NTIS, PC A22/MF A01 - OSTI.

Results are reported for two-dimensional discrete ordinates, X-Y geometry calculations performed for seven Halden Heavy Boiling Water Reactor core configurations. The calculations were performed in support of an effort to reassess the neutron fluence received by the reactor vessel. Nickel foil measurement data indicated considerable underprediction of fluences by the previously used multigroup removal- diffusion method. Therefore, calculations by a more accurate method were deemed appropriate. For each core configuration, data are presented for (1) integral fluxes in the core and near the vessel wall, (2) neutron spectra at selected locations, (3) isoflux contours superimposed on the geometry models, (4) plots of the geometry models, and (5) input for the calculations. The initial calculations were performed with several mesh sizes. Comparisons of the results from these calculations indicated that the uncertainty in the calculated fluxes should be less than 10%. However, three-dimensional effects (such as axial asymmetry in the fuel loading) could contribute to much greater uncertainty in the calculated neutron fluxes. 7 refs., 22 figs., 11 tabs.

2105 Power Reactors, Breeding

Refer also to citation(s) 42740, 42782, 42786, 42789, 42790, 42803, 42811

42708 (IAEA-TECDOC–550, pp. 277-284) **Safety aspects of new LMFBR designs in Europe.** Bacher, P. (Electricite de France, 75 - Paris (France). Direction de l'Equipement); Hubert, G. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The licensing and start up of the Creys Malville 1200 MWe LMFBR (SPX1) and the safety analysis performed on the other European projects (SPX2, SNR2, CDFR) form a sound basis for the safety approach of the new European Fast Reactor (EFR) project. Prevention of whole core accidents, development of passive safety features taking benefits of the specific characteristics of pool type LMFBR, consistency in the containment strength to avoid weak point and cliff edge effects, allowance for adaptation to different national licensing procedures without major design differences in the NSSS, are some of the main safety orientations of the EFR project. Further studies will allow to present some options, for example concerning the containment (e.g. hung or anchored safety vessel) or the decay heat removal systems (probabilistic assessment). However, previous studies give assurance that, in all case, design solutions already developed or under development, are able to satisfy stringent safety requirements. (author). 1 tab.

42709 (IAEA-TECDOC–550, pp. 285-299) **Safety aspects of the U.S. advanced LMR design.** Pedersen, D.R. (Argonne National Lab., IL (USA)); Marchaterre, J.F.; Gyorey, G.L.; Rosen, S. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The cornerstones of the United States Advanced Liquid Metal Cooled Reactor (ALMR) program sponsored by the Department of Energy are: the plant design program at General Electric based on the PRISM (Power Reactor Innovative Small Module) concept, and

the Integral Fast Reactor program (IFR) at Argonne National Laboratory (ANL). The goal of the U.S. program is to produce a standard, commercial ALMR, including the associated fuel cycle. This paper discusses the (1) U.S. regulatory framework for design of an ALMR, (2) safety aspects of the IFR program at ANL, (3) the IFR fuel cycle and actinide recycle, and (4) the ALMR plant design program at GE. (author). 6 refs, 5 figs.

42710 (IAEA-TECDOC–550, pp. 301-310) **Some aspects of next-generation fast reactor safety.** Bagdasarov, Yu.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

In the paper variation in general approaches to validation of nuclear power plant (NPP) safety in the USSR in the last few years is followed. On the basis of this analysis and present-day knowledge a concept of fast reactor units of increased and feasibly attainable safety is proposed taking into account the elements of both deterministic and probabilistic approaches. The results of the BN-800 power unit evaluation from the viewpoint of these concept requirements are presented. (author). 1 fig., 1 tab.

42711 (IWGFR–70, pp. 168-172) **Review of activities of the Commission of the European Communities relating to fast reactors in 1988.** Batz, W. (Commission of the European Communities, Brussels (Belgium)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors. Jul 1989. (CONF-8904364–: 22. annual meeting of the International Working Group on Fast Reactors, Vienna (Austria), 18-21 Apr 1989). In *Status of national programmes on fast breeder reactors: Twenty-second annual meeting Vienna, 18-21 April 1989.* Order Number DE90634121. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

Commission of the European Communities (CEC) is performing fast reactor activities in two areas: (1) coordination and harmonization and (2) research. Coordination and harmonization activities are carried out in the frame of the Fast Reactor Co-ordinating Committee (FRCC). At present CEC is examining possible support schemes which include a contribution to R-D and/or to a EFR design effort. In line with current CEC R-D activities a possible research support would be in the field of safety. Round robins on the determination of residual stress in cold worked materials and on the stress relaxation properties of austenitic stainless steels were accomplished. Studies were performed on high cycle fatigue of austenitic stainless and stress rupture properties of 9-12 Cr steels. Work performed at the Ispra establishment is related to LMFBR safety, while the activities carried out at Karlsruhe concern fast breeder fuels. Safety research at Ispra comprises investigation and analysis of severe accident phenomena under three main projects: FARO, EAC and PAHR in-pile. The short-term nitride irradiation experiments NILOC 1 and 2 were analysed in detail and compared with the previous short-term carbide irradiations CARLO and CARRO which had been performed under partly identical conditions as NILOC 2. In the context of an industrial project to transmute long-lived actinides in nuclear waste into short-lived fission products in a dedicated fast reactor, a study was launched to determine the thermodynamics and the metallurgical characteristics of alloys of uranium-plutonium-zirconium with various amounts of the minor actinides neptunium, americium, and curium. First experimental data on the specific heat of refractory metals and UO_2 at and above their melting temperatures were obtained with newly developed equipment using laser pulse heating and ultra fast multiwavelength pyrometry. (Abstract Truncated)

42712 (IWGFR–70, pp. 123-128) **A review of the United Kingdom fast reactor programme.** Bramman, J.I. (UKAEA Fast Reactor Development Directorate, Risley (UK)); Hickey, H.B.; Wheeler, R.C.; Gregory, C.V. International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors. Jul 1989. (CONF-8904364–: 22. annual meeting of the International Working Group on Fast Reactors, Vienna (Austria), 18-21 Apr 1989). In *Status of national programmes on fast breeder reactors: Twenty-second annual meeting Vienna, 18-21 April 1989.* Order Number DE90634121. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

Total electricity generating capacity in UK is approx. 54 GW. Total electricity generation in 1988 was 288 TW hours, of which just over 20% was nuclear. In Scotland percentage of electricity generated by nuclear stations was 49% of the total, and will exceed 60% in 1989. Privatization of the Electricity Supply Industry (ESI) in the UK is proceeding on schedule. Considerable efforts are being made to ensure that the maximum benefits will be obtained from operating the PFR during the next five years. The main thrust of the UKAEA's programme continues to be towards the requirements of the EFR. Reload 16 included the biennial maintenance and statutory inspection period. It was extended from its original 60 days by the need to carry out modifications aimed at improving the reliability of the protection systems designed to safeguard the components of the secondary circuit, including the IHXs, in the event of a sodium water reaction in a steam generator unit, and by the need to inspect and repair the vessels of the steam generator units. Good progress was made with the fuel development programme. The leading experimental cluster of PE16-clad 6.6 mm diameter pins is continuing irradiation above 21% burnup and 150 dpa (NRT). The lead subassembly with 5.8 mm pins clad in PE16 has exceeded 17.6% burnup, 130 dpa (NRT). The leading subassembly with pins of the same type to have undergone complete PIE contained fuel at 16% burnup and PE16 clad at 116 dpa; these pins were found to be in very good condition. Radial blanket subassemblies have exceeded 2% burnup without failure. In 88/89 there was one reprocessing campaign in the PFR Reprocessing Plant lasting from November 1988 to February 1989. Feed material included irradiated fuel from 12 subassemblies irradiated in the PFR, some unirradiated subassemblies and loose pins and residues; in all containing 1.3t of Heavy Metal (HM) containing 242 kg plutonium.

42713 (IWGGCR–18, pp. 136-142) **Creep and fatigue crack growth in tubes of HTR components.** Roedig, M. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Pfaffelhuber, M.; Schubert, F.; Nickel, H.; Bodmann, E. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

As part of the German Projects PNP and HTR 500, experiments on the transferability of fracture mechanics data have been performed. The aim was to work out laws, which are able to describe creep and fatigue crack growth in components at high temperatures. In the creep crack growth experiments, steam reformer tubes of 120 mm o.d. and 10 mm w.th. were provided with an external 360 deg.- crack in circumferential direction. The loading condition was axial tension with superimposed internal pressure. The temperature was 800 deg. C. As a result of the experiments it was found, that creep crack growth in standard specimens as well as in tubes can be described by means of the loading parameter C*. The fatigue crack growth experiments have been performed with a thick walled tube of 197 mm o.d. and 23.5 mm w.th. at 550 deg. C. The tube has been provided with an external 180 deg.-crack in circumferential direction. It was loaded at a frequency of 5 Hz in four point bending. After the first evaluation of results, the comparison of the da/dN vs. Δ KI curves for standard specimens and tubes show a poor agreement. The reason is thought to be in too conservative assumptions in the calculation of the KI-values. (author). 10 refs, 11 figs.

42714 PRISM: The plant design concept for the U.S. advanced liquid metal reactor program. Berglund, R.C. (GE Nuclear Energy, Advance Nuclear Technology, San Jose, CA (US));

Tippets, F.E. *Proceedings of the American Power Conference (USA)*, 51: 697-703 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

The US program for development of an advanced liquid metal reactor (ALMR) is proceeding into a new phase of focused design development. This new phase started at the beginning of 1989; its objective is to complete the conceptual design of the US ALMR, with supporting key feature tests, sufficiently to enter a more detailed design phase and subsequent construction of a prototype reactor plant. A project goal is to demonstrate by actual performance of the reactor its passive, inherent safety features and thereby provide the technical basis for certification of the design by the Nuclear Regulatory Commission (NRC). This paper reports on the PRISM (power reactor inherently safe module) reactor concept which in combination with the IFR (integral fast reactor) metal fuel cycle being developed by Argonne National Laboratory, was selected by DOE in 1988 as the reference design for the US ALMR program.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

42715 (GPO–23-835) **Nuclear power in space.** Committee on Science, Space and Technology (U.S. House). 1989. 185p. Source: Subcommitttee on Energy Research and Development, House of Representatives, Washington, D.C. 20515 HC free.

Written and verbal testimony presented before the House Subcommittee on Energy Research and Development is documented. Current research efforts related to space nuclear power are discussed including the SP-100 Space Reactor Program, development of radioisotope thermoelectric generators, and the Advanced Nuclear Systems Program. Funding, research and test facilities, specific space mission requirements, and the comparison of solar and nuclear power systems are addressed. Witnesses included representatives from DOD, NASA, DOE, universities, and private industry.

42716 (N–90-22847) **Nuclear technology and the space exploration missions.** Brandhorst, H.W.; Sovie, R.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 11p. (NASA-TM–103156;E–5518;NAS–1.15:103156;CONF-900801–: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Source: NTIS, PC A03/MF A01.

The strategy for a major exploration initiative leading to permanent human presence beyond earth orbit is still being developed; however enough is known to begin defining the role of nuclear technologies. Three broad areas are discussed: low power (less than 10 kWe) rover/vehicle power systems; integrated, evolutionary base power systems (25 to 100 kW) and nuclear energy for electric propulsion (2 to 100 MWe); and direct thermal propulsion (1000s MW). A phased, evolutionary approach is described for both the moon and Mars, and the benefits of nuclear technologies relative to solar and their integration are described.

2107 Regulation and Licensing

Refer also to citation(s) 42669, 42670, 42709, 42714, 42745, 42775, 42779

42717 (NUREG–0540-Vol.12-No.3) **Title list of documents made publicly available, March 1–31, 1990: Volume 12, No. 3.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1990. 447p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A19/MF A01 - GPO; OSTI; INIS.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy Publication Power Reactor Docket Information, last published in January 1979.

42718 (NUREG–0540-Vol.12-No.4) **Title list of documents made publicly available, April 1–30, 1990: Volume 12, No. 4.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1990. 320p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A14/MF A01 - GPO; OSTI; INIS.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979.

42719 (NUREG–0540-Vol.12-No.5) **Title list of documents made publicly available, May 1–31, 1990: Volume 12, No. 5.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1990. 410p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A18/MF A01 - GPO; OSTI; INIS.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

42720 (NUREG–0750-Vol.31-No.5) **Nuclear Regulatory Commission issuances, May 1990: Volume 31, No. 5.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. May 1990. 116p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

42721 (NUREG/CR–2000-Vol.9-No.6) **Licensee Event Report (LER) compilation for month of June 1990: Volume 9, No. 6.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Jul 1990. 87p. Sponsored by Nuclear Regulatory Commission. (ORNL/NSIC–200-Vol.9-No.6). Source: NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 –

Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

42722 (REG/G–1.35.1) **Determining prestressing forces for inspection of prestressed concrete containments.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Jul 1990. 12p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

General Design Criterion 53, "Provisions for Containment Testing and Inspection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that the reactor containment be designed to permit (1) periodic inspection of all important areas and (2) an appropriate surveillance program. Regulatory Guide 1.35, "Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containment Structures," describes a basis acceptable to the NRC staff for developing an appropriate inservice inspection and surveillance program for ungrouted tendons in prestressed concrete containment structures of light-water-cooled reactors. This guide expands and clarifies the NRC staff position on determining prestressing forces to be used for inservice inspections of prestressed concrete containment structures.

2108 Economics

Refer also to citation(s) 42684, 42859, 43589

42723 (IAEA-TECDOC–550, pp. 64-65) **The greenhouse effect and acidification.** Velez, C. (Instituto Nacional de Investigaciones Nucleares, Mexico City (Mexico)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some general aspects concerning power generation in Mexico and acid rain are discussed.

42724 (IAEA-TECDOC–550, pp. 83-94) **Main issues requiring resolution for large scale deployment of nuclear energy.** Giraud, A. (Commissariat a l'Energie Atomique, Rocquencourt (France)); Vendryes, G. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

A new development of the nuclear energy in the world would certainly start in the United States: this paper is centered on this hypothesis. The fast development of nuclear energy in France is interesting to observe in order to use elsewhere some of its characteristics: the care for being reasonably independent in the energy field played an important role in the decisions taken around 1973, at the time of the oil crisis. The safety organization remains narrowly linked to the technicians thanks to its Institute which is an autonomous part of the Atomic Energy Commissariat. The responsible organizations, being very few (including the only utility, EDF) can have a very fruitful dialogue between them and with the safety authorities. Building standardized stations has lowered the construction time and the price. The public acceptance has been helped by some financial measures and by an important information effort: visits in the stations have been a big success. Much remains to be done, in particular in the waste field. Do we have to launch new, revolutionary reactor types? We are personally in favor of evoluting existing types without any deep changes. (author). 6 figs.

42725 (IAEA-TECDOC–550, pp. 98-100) **Some comments on future needs for nuclear power.** Yagawa, G. (Tokyo Univ. (Japan)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Nuclear energy is unavoidable from the viewpoint of global environment, world economy and energy security in industrialized as well as developing nations. Assuming safe operation of nuclear plants is the only way to ensure public support for nuclear energy. The development of more safe plants with passive safety is urgent, especially for developing countries.

42726 (IAEA-TECDOC–550, pp. 100-105) **Future needs for nuclear power.** Calleja, A.T. (Iberduero, SA, Bilbao (Spain)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some general aspects concerning the future of nuclear energy for electricity generation are discussed with regard to public opinion and economy.

42727 (IAEA-TECDOC–550, pp. 106-110) **Who needs nuclear power?.** Jones, P.M.S. (UKAEA Headquarters, London (UK)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

After a short definition of terms, the author discusses the arguments against and pro nuclear power and a few energy demand scenarios. 26 refs.

42728 (IAEA-TECDOC–550, pp. 110-113) **Future needs for nuclear power.** Starr, C. (Electric Power Research Inst., Palo Alto, CA (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Starting from the global energy demand it is demonstrated that even with a full conservation program, both an increase in fossil fuel and nuclear generating plants is inevitable. Nuclear eventually

must carry the major expansion if fossil fuel use is constrained by environmental or economic factors. The main future dependence will be on fossil fuels, primarily coal, and nuclear power. 4 figs, 1 tab.

42729 (IAEA-TECDOC–550, pp. 473-476) **Status and trends in nuclear power development in Italy.** Petrangeli, G. (Directorate for Nuclear Safety and Health Protection (ENEA/DISP), Rome (Italy)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The status and trends in nuclear power development in Italy following the resolution passed in the Parliament in December 1987 which, among other instructions, pledged the Government not to plan for new nuclear power plants over the subsequent five years and to start concrete initiatives in the fields of research and applications of passive safety reactors are discussed. 4 refs.

42730 (IAEA-TECDOC–550, pp. 477-479) **Where do we go from here?.** Alonso, A. (Polytechnical Univ. of Madrid (Spain)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some aspects concerning the importance of education in the large foreseen deployment of nuclear power in the next century are discussed.

42731 (IAEA-TECDOC–550, pp. 480-489) **Status and trends in nuclear power development in the Union of Soviet Socialist Republics.** Abagyan, A.A. (All-Union Research Inst. for Nuclear Power Plant Operations, Moscow (USSR)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The status and trends in nuclear power development in the USSR, in particular the WWER plants, are discussed in connection with the actual and required safety levels of these plants. 6 figs.

42732 (KFK–4589 II.1-II.15) **Disposal of advanced LWR fuel elements: Concepts and approaches.** Stoll, W. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1989. (In German). (CONF-8811333–: KTG conference on advanced LWR fuel elements: Design, performance and reprocessing, Karlsruhe (Germany, F.R.), 17-18 Nov 1988; PWA–25/89). In *Compilation of papers presented to the KTG conference on 'Advanced LWR fuel elements: Design, performance and reprocessing', 17-18 November 1988, Karlsruhe Nuclear Research Center.* Order Number DE90512716. Source: NTIS (US Sales Only), PC A08/MF A01.

The economic marginal conditions for several stages of the fuel cycle have changed dramatically, which is illustrated by the change in the uranium price. In this connection, much depends on the methods of uranium enrichment. Reprocessing and final storage are examples for high fixed costs. The reprocessing strategy is a special chapter. Some approaches to the fuel element and fuel cycle are shown in a historical frame. (DG).

42733 (KFK–4641) **The nuclear fuel cycle with advanced reactor systems - analysis of its economic fundamentals and possibilities.** Klumpp, P. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Stabsabteilung Innenrevision; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Wirtschaftswissenschaften. Apr 1990. 238p. (In German). Order Number DE90512939. Source: NTIS (US Sales Only), PC A11/MF A01.

The purpose of the study is to analyse the nuclear fuel cycle of alternative advanced reactor systems with respect to their different mass flows of nuclear fuel and to judge the economic feasibility of these advanced nuclear technologies using a specific fuel cycle model. It is the particular importance of this subject that many technical, physical, political and economic coherences are combined in a very complex manner. A detailed description of the problem is given in the introductional chapter 1. The following chapter 2 gives a sufficient survey of the different techniques and technical facilities of the nuclear fuel cycles in question. Part 3 includes an investigation of logical coherences between typical fuel cycle mass flows which consequently leads to a mathematical model. This model is described in part 4. Chapter 5 then deals with the application of this model by the quantitative estimation and valuation of the economic differences between the conventional and advanced nuclear technology. In the final part of this study the influence of a very important parameter in this context, the price of plutonium, is discussed with respect to the time of introduction of the advanced reactor technology under economic conditions. (orig.).

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

42734 (CTA-IEAv-RI–03/87) **Integral parameters for the Godiva benchmark calculated by using theoretical and adjusted fission spectra of ^{235}U.** Caldeira, A.D. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. May 1987. 9p. (In Portuguese). Order Number DE90635470. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The theoretical and adjusted Watt spectrum representations for ^{235}U are used as weighting functions to calculate K_{eff} and $\delta_f^{28}/\delta_f^{25}$ for the benchmark Godiva. The results obtained show that the values of K_{eff} and $\delta_f^{28}/\delta_f^{25}$ are not affected by spectrum form change. (author).

2202 Components and Accessories

Refer also to citation(s) 42585, 42586, 42587, 42589, 42590, 42591, 42594, 42595, 42596, 42597, 42598, 42601, 42685, 42722, 42779, 42781, 42783, 42787, 42791, 42792, 42793, 42794, 42795, 42799, 42800, 42801, 42808, 42809, 42993

42735 (NUREG–1377-Rev.1) **NRC research program on plant aging: Listing and summaries of reports issued through May 1990: Revision 1.** Kondic, N.N.; Hill, E.L. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering. Jul 1990. 56p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

The US Nuclear Regulatory Commission is conducting the Nuclear Plant Aging Research (NPAR) Program. This is a comprehensive hardware-oriented engineering research program focused on understanding the aging mechanisms of components and systems in nuclear plants. The NPAR program also focuses on methods for simulating and monitoring the aging-related degradation of these components and systems. In addition, it provides recommendations for effective maintenance to manage aging and for the implementation of the research results in the regulatory

process. This document contains a listing and index of reports generated in the NPAR Program that were issued through May 1990 and summaries of those reports. Each summary describes the elements of the research covered in the report and outlines the significant results. For the convenience of the user, the reports are indexed by personal author, corporate author, and subject.

42736 **Mechanistic model for void distribution in flashing flow.** Riznic, J. (Boris Kidric Institute of Nuclear Sciences, Belgrade (YU)); Afgan, N.; Ishii, M. pp. 699-717 of Transient phenomena in multiphase flow. Afgan, N.H. Hemisphere Publishing, New York, NY (USA) (1988).

A model for the flashing process is proposed and based on the wall nucleation theory, bubble growth model and drift-flux bubble transport model. The model predictions are compared to Moby Dick and BNL experimental data. They show that satisfactory agreements could be obtained from the model. This result indicates that the mechanistic prediction of the flashing phenomenon is possible based on the present wall nucleation based model.

2203 Fuel Elements

Refer also to citation(s) 42394, 42962

42737 (IAEA-TECDOC–550, pp. 469-470) **Fuel cycle safety evaluation.** Morelle, J.M. (Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The numerous steps of the fuel cycle each have their own technicalities and for each of them safety evaluations have been conducted. However, the fuel cycle should be seen as a whole, i.e. as one single "system", not only as a sequence of steps.

2204 Control Systems

Refer also to citation(s) 42781, 42782, 42785, 42789, 42813

42738 (CDTN-DETR-PD–016/85) **Training of operators in a research reactor.** Horta, J.A.L. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 25 Mar 1985. 6p. Order Number DE90635538. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The main objectives of a training course for Nuclear Power Plant operators, using basic tool its 100 Kw research reactor TRIGA-Mark I (IPR-R1) applied by the Reseacrh and Development Center of Nuclebras are described. (C.M.).

42739 (IAEA-TECDOC–550, pp. 561-573) **CANDU computerized safety system.** Popovic, J.R. (Atomic Energy of Canada Ltd, Mississauga, ON (Canada). CANDU Operations); Hinton, G.J. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

In CANDU 6 PHW reactors, automatic reactor trip has been carried out with digital computers since 1982. The introduction of computers in the CANDU shutdown systems was motivated by the excellent operating experience with digital systems used for direct digital control of the CANDU generating stations and by new licensing requirements for increased CANDU 6 trip coverage redundancy. This paper summarizes the evolution of digitally based design to meet these requirements, the system configuration of a fully computerized shutdown system and the associated design philosophy, software and hardware qualification process, and the operating experience of the existing installations. The fully computerized Shutdown System is described for the Darlington Nuclear Generating Station scheduled to be in-service in 1990. Future design developments are also discussed. (author). 10 refs, 4 figs.

42740 (ORNL/TM–11134) **Implementation of multivariable control techniques with application to Experimental Breeder Reactor II.** Berkan, R.C. (Tennessee Univ., Knoxville, TN (USA). Dept. of Nuclear Engineering); Upadhyaya, B.R.; Kisner, R.A. Oak Ridge National Lab., TN (USA). Jun 1990. 50p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90014787. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

After several successful applications to aerospace industry, the modern control theory methods have recently attracted many control engineers from other engineering disciplines. For advanced nuclear reactors, the modern control theory may provide major advantages in safety, availability, and economic aspects. This report is intended to illustrate the feasibility of applying the linear quadratic Gaussian (LQG) compensator in nuclear reactor applications. The LQG design is compared with the existing classical control schemes. Both approaches are tested using the Experimental Breeder Reactor 2 (EBR-2) as the system. The experiments are performed using a mathematical model of the EBR-2 plant. Despite the fact that the controller and plant models do not include all known physical constraints, the results are encouraging. This preliminary study provides an informative, introductory picture for future considerations of using modern control theory methods in nuclear industry. 10 refs., 25 figs.

42741 **An expert system to estimate time, rate, and magnitude of release of important radioactive isotopes given a loss of containment integrity.** Kim, K.Y. (Cekmece Nuclear Research Center, Istanbul (Turkey)); Okrent, D. *Nuclear Technology (USA),* 89(1): 126-129 (Jan 1990).

A prototype expert system is developed to provide information to emergency planners on the time, rate, and magnitude of release of important radioactive isotopes given a loss of containment integrity. Basic to the method is the anticipated availability of instruments to measure concentration of significant individual radioisotopes in containment ~ 1/min. The escape of radioisotopes is assumed to be proportional to that of noncondensable gases, which are monitored and/or predicted in part.

42742 **Dynamic range and time response of a new hafnium neutron detector.** Randolph, H.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). *Proceedings of the American Power Conference (USA),* 51: 722-724 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper reports on a hafnium neutron detector evaluated for use in measuring shut-down speed of a reactor during fast scram tests. The detector measured neutron flux over a dynamic range of eight decades and responded in a time that was short compared to 50 microseconds. Response was determined inside the cavity of a Godiva reactor operated in continuous and pulsed modes to generate power levels from 100 watts to 10^{10} watts. The detector will provide neutron measurements previously unavailable for pulsed reactors and is already being used for the fast response part of an in-core reactor power monitor.

42743 **Time domain synthesis of robust controllers for space nuclear power systems.** Parlos, A.G. (Texas A and M Univ., College Station, TX (USA). Dept. of Nuclear Engineering); Tsai, W.K. *IEEE Transactions on Nuclear Science (Institute of Electrical and Electronics Engineers) (USA),* 37(2): 1053-1064 (Apr 1990).

Many control problems demand hard constraints on system variables because of physical limitations related to safety. Although results relating to energy bounds and probabilistic bounds are numerous, corresponding results on hard constraints are scattered

and have not been adequately treated in the literature. A group of work specifically dealing with hard constraints is the research on the unknown-but-bounded (UBB) description of uncertainty for linear systems. Ellipsoid bounds have been extended to account for system parameter variations. An algorithm is presented for the time domain synthesis (design) of control systems which inherently exhibit robustness to system parameter variations. The theoretical results are applied for thee regulation of a simplified model of a gas-cooled space nuclear power system, which exhibits uncertainty in its reactivity coefficients. Results indicate that appropriate selection of the uncertain system parameter bounds allows design of regulators that exhibit desired stability and performance characteristics—compliance with the imposed constraints—throughout the range of the parameter uncertainty.

2205 Environmental Aspects

Refer also to citation(s) 42741, 43260

42744 (CDTN-DERL-PD-005/82) **Water and earth uses, habits and nutritional diets in adjacent regions of places selected to site 4 and 5 nuclear power plants.** Damasceno, M.A.P.; Coelho, C.P. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 8 Mar 1982. 82p. (In Portuguese). Order Number DE90635305. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

A way of life study on adjacent region of 4 and 5 Nuclear Power Plants aiming at environmental impacts evaluation, development environmental monitoring programs and safety analysis report of the area is presented. (C.M.).

42745 (IAEA-TECDOC–550, pp. 263-273) **A process for resolving safety and institutional issues of advanced reactors: Replacing public concern with confidence.** Rogers, K.C. (Nuclear Regulatory Commission, Washington, DC (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The paper discusses the constructive role the regulator can provide in helping resolve the safety and regulatory institutional issues involved in the introduction of advanced reactors. 4 refs.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 42707, 42734, 42738, 42740, 42810

2207 Plutonium and Isotope Production Reactors

42746 (CONF-9005247–1) **The influence of displacement rate on damage accumulation during the point defect transient in irradiated materials.** Stoller, R.E.; Mansur, L.K. Oak Ridge National Lab., TN (USA). [1990]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on radiation material science; Alushta (USSR); 22-25 May 1990. Order Number DE90014450. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The influence of displacement rate has been extensively investigated using the rate theory of radiation effects. The focus of previous work was on relatively high dose, high temperature phenomena such as irradiation creep and void swelling. That work examined a regime in which the vacancy and interstitial concentrations rapidly reach their steady state values. Recently, there have been observations of greater-than-expected levels of damage accumulation during low temperature neutron irradiation. In one case, accelerated irradiation creep was observed for irradiation temperatures below 300°C and, in another case, accelerated embrittlement of the HFIR pressure vessel was observed at 60°C. In both cases, displacement rate is a potentially significant variable. For such low irradiation temperatures, the point defect concentrations do not reach their steady state values during the irradiation. A detailed numerical analysis has been conducted to investigate the influence of displacement rate in this regime where the point defect concentrations are obtained explicitly as a function of time (dose). The results of this analysis indicate that the details of the point defect transient are significant when modeling damage accumulation at low temperatures. 11 refs., 9 figs.

2208 Propulsion Reactors

Refer also to citation(s) 42743

2209 Reactor Safety

Refer also to citation(s) 42583, 42585, 42586, 42587, 42589, 42590, 42591, 42594, 42595, 42596, 42597, 42598, 42601, 42669, 42675, 42735, 42741, 42853

42747 (CEA-DAS–635) **What actually happened at TMI-2.** Duco, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire). CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Aug 1989. 96p. (In French). (CONF-8905339–: SFEN day on TMI reactor accident. Balance ten years after, Paris (France), 30 May 1989). Order Number DE90511913. Source: NTIS (US Sales Only), PC A05/MF A01.

The 1979 Three Mile Island Unit 2 (TMI-2; USA) accident is evaluated. The reactor core is damaged and the released fission products contaminated the reactor building and the secondary buildings. The radiation dose on the TMI-2 personnel is about 4694 man-rem, from 1979 to 1987. The main steps of the accident and the TMI-2 decontamination actions are described. The accident showed the importance of the reactor vessel's water re-filling as soon as possible during accident.

42748 (IAEA-TECDOC–550) **Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. 673p. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The Workshop presentations were divided into sessions devoted to the following topics: Environmental impact of fossil fuel energy technologies (5 papers), Future needs for nuclear power (7 papers), Safety objectives (10 papers), Safety aspects of the next generation of current-type nuclear power plants (8 papers), Safety aspects of new designs and concepts for nuclear power plants (6 papers), Special safety issues: Safety aspects of new designs and concepts for nuclear power plants (5 papers), Safety aspects of new designs and processes for the nuclear fuel cycle (5 papers), Closing panel (3 papers), 12 poster presentations and a Summary of the Workshop. A separate abstract was prepared for each of these papers. Refs, figs and tabs.

42749 (IAEA-TECDOC–550, pp. 95-97) **Safety approach evaluation for future light water power plants.** Noviello, L. (Ente Nazionale per l'Energia Elettrica (DSR) (Italy)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some general aspects concerning a safety approach in the design of the new light water nuclear power plants are discussed.

42750 (IAEA-TECDOC–550, pp. 129-134) **The INSAG-3 basic safety principles.** Kouts, H.J.C. (Brookhaven National Lab., Upton, NY (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The report of the International Nuclear Safety Advisory Group on Basic Safety Principles for Nuclear Power Plants (INSAG-3) is discussed. The fundamental and the specific principles as well as their application to plants of future types are presented. (author).

42751 (IAEA-TECDOC–550, pp. 135-138) **Safety objectives and principles for nuclear power plants (75-INSAG-3).** Rogers, J.T. (Carleton Univ., Ottawa, ON (Canada). Dept. of Mechanical and Aerospace Engineering). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The Advisory Committee for Nuclear Safety (ACNS) to the Atomic Energy Control Board (AECB), the Canadian regulatory agency, reviewed the International Atomic Energy Agency Safety Series No. 75-INSAG-3 "Basic Safety Principles for Nuclear Power Plants", in the light of previous ACNS reports. The results of the review are given in ACNS report ACNS-16. Some specific comments provided in ACNS-16 are discussed here. 13 refs.

42752 (IAEA-TECDOC–550, pp. 138-141) **Some general ideas for discussion on the subject of safety goals and objectives.** Palomo, J. (Hidroelectrica Espanola, Madrid (Spain)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Establishment of some kind of safety goals and objectives, based upon the extended use of probabilistic risk and safety assessments is needed, and therefore this subject is gaining increased acceptance in the nuclear community as an appropriate mechanism for dealing with residual risk of nuclear power plants operation.

42753 (IAEA-TECDOC–550, pp. 171-175) **Safety objectives for large-scale deployment of nuclear power.** Schenk, H.J. (Kernkraftwerk Philippsburg GmbH (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Safety objectives for large-scale deployment of nuclear power should be achieved by: continuity in the development of successful design, capable industrial infrastructures, fuel integrity up to a very high burn-up, consequent confinement of radioactive waste, safe final storage, possibility to exclude severe accidents for the environment based on design features and a reasonable accident management. 5 figs.

42754 (IAEA-TECDOC–550, pp. 175-176) **Safety objectives for large-scale deployment of nuclear power.** Sato, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The basic safety objectives for nuclear power plants should be common worldwide. We should be aware of the international nature of nuclear safety. The level of safety of any nuclear installation must be sufficiently high without exceptions all over the world.

42755 (IAEA-TECDOC–550, pp. 176-181) **Some future developments in safety objectives.** Hannaford, J. (Health and Safety Executive, Bootle (UK). Nuclear Installations Inspectorate). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The main part of this paper deals with the Health and Safety Executive's (HSE) proposals on tolerability of risk and the implications for the Nuclear Installations Inspectorate (NII), particularly as far as societal risk is concerned. The topic of human factors is widely recognized as important. The concern about developments in the use of computerized protection systems and, in particular, about the software used in them, involves a specific aspect of human factors. 6 refs.

42756 (IAEA-TECDOC–550, pp. 187-194) **Safety aspects of next-generation CANDU reactors.** Brooks, G.L. (Atomic Energy of Canada Ltd, Mississauga, ON (Canada). CANDU Operations). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Since it is obvious that safety improvements should be evolved within the context of a coordinated overall reactor development program, the paper firstly discusses the overall requirements established for next-generation CANDU reactors. Specific safety-related requirements are then identified within the context of these overall requirements. Finally, the paper describes the general directions being followed to satisfy these safety-related requirements. The overall requirements for next-generation CANDU reactors have been established to satisfy the needs of a broad spectrum of "stakeholders' in the projected rebirth of the nuclear power industry. Such stakeholders include the general public, the owner utilities, regulatory bodies, and political leaders. All of these stakeholders have a vital interest in safety. Most do, however, have other needs which must also be satisfied, e.g., economic electrical generation to name but one. A balanced approach is therefore appropriate and, indeed, essential. Fortunately, with such a balanced

approach, worthwhile safety improvements can, and will, be achieved while satisfying these other stakeholder needs. Much is heard today of concepts such as "inherent safety" and "passive safety". These concepts are discussed, both in general and in the context of CANDU development. While future CANDU reactors will embody appropriate application of these concepts, the emphasis in CANDU development will be on logical evolution rather than on revolutionary new design concepts. (author). 3 refs.

42757 (IAEA-TECDOC–550, pp. 195-202) **Safety aspects of advanced PWR designs in France.** Bacher, P. (Electricite de France, 75 - Paris (France). Direction de l'Equipement). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

After a broad introduction explaining the French conception of a global approach to safety, based upon feed-back of experience, upon the use of both passive and active safety features, upon the quality and the reactivity of man, and upon an in depth defense and an in depth culture, the status of the present advanced light water reactor N4 is described. The global probabilistic safety objective of a core damage due to internal events of the order of 10^{-5}/ reactor year appears to be reached, and this result is achieved in a balanced manner, no individual failure path being responsible for more than 1 or 2.10^{-6}. This is quantitatively satisfactory, as accident management measures reduce by a significant figure the severe accident probability. The discussion of improvements for future plants concludes that qualitative, not quantitative, progress is necessary. Such an analysis has been undertaken in France in the REP 2000 program, and a few examples are given, both for the evolutionary type of reactor derived from N4 or Konvoy and for semi-revolutionary types such as AP 600. The conclusion is that whatever the types of reactors, the requirements for the next generation of reactors, to be built at the turn of the century, will most likely be worldwide or at least European and not French, or German, or British, or Spanish... (author). 7 refs, 1 tab.

42758 (IAEA-TECDOC–550, pp. 182-184) **Application of safety objectives to safety standards at the next stages of nuclear power deployment.** Sidorenko, V.A. (USSR State Committee for Supervision of Nuclear Power Safety, Moscow (USSR)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The new edition of "General Principles for NPP Safety" was being worked out in the Soviet Union. This is the top document in the hierarchy of safety standards that regulate nuclear safety. The document is to become valid beginning from June 1990. Some safety targets expressed in probabilistic terms are introduced in this paper.

42759 (IAEA-TECDOC–550, pp. 145-157) **The case for more stringent safety criteria.** Ahearne, J.F. (Sigma Xi, New Haven, CT (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

More stringent safety criteria may be needed to guide design of advanced reactors, although the NRC safety goals provide an adequate design envelope, and INSAG-3 describes a suitable process. New designs do raise issues which go beyond current criteria, and may require additional criteria. A major question is when will a prototype be required. New criteria could be proposed to win public acceptance of nuclear power. Public acceptance will not be gained easily, and will require government and industry implementing new developments in risk communication. (author). 20 refs.

42760 (IAEA-TECDOC–550, pp. 159-170) **One utility's point of view.** Carle, R. (Electricite de France (France)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

A utility operating a nuclear plant is legally responsible for the safety of this plant. The safety strongly depends on the quality of operation. The safety of the existing plants is good but can be improved. To achieve this goal we must take benefit of the experience feedback, the probabilistic reliability analysis and the modern methods of operators training. International exchange of information, for example in the framework of IAEA or WANO, improves the number of data available and is of utmost importance. At the beginning of the next century we shall have to choose the plants which will replace the existing ones at the end of their life. To prepare this decision we must keep in mind: the interest of using existing experience; the importance of keeping a good balance between automatic systems and human action; the progress which could be made by using passive systems, but we should be careful not to discredit current technology by the hope of so called inherently safe reactors, which will never exist. Choosing small-sized reactors could have some advantages but would increase the cost; in fact, size is strongly dependent on the clients' needs. Only a limited number of standardized systems should be developed in the future. Finally, quality of these systems will be the key to achieve better safety, in the continuity of past achievements. (author).

42761 (IAEA-TECDOC–550, pp. 203-219) **Safety aspects of advanced LWR designs in the Federal Republic of Germany.** Maerkl, H. (Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Lack of public acceptance in most industrialized countries impedes expansion of nuclear energy. Regain and reestablishment of public acceptance demand safety performance improvements needed to convince the public that risk of a severe accident will be further decreased and, also, that even an accident sequence exceeding the design basis will not expose the environment to an unacceptable radiological impact. Probabilistic risk analysis has proven to be an excellent instrument for identifying safety improvement needs. The recently commissioned 1300 MW Konvoi PWR plants have already achieved a highly acceptable level of safety, the frequency of an accident event not coped with by the safety systems amounting to approximately $1.4x10^{-6}$ per year. Following a predominantly evolutionary way of safety improvements the

proven safety features are to be maintained also for the next generation of NPPs since one of the most important criteria of design advance is reflection of operating experience and incorporation of proven technology. In addition, however, some potential safety performance improvements merit consideration, especially in the following areas: A novel I and C system using exclusively digital microprocessor-based technology as, e.g., presently under advanced development at Siemens will contribute markedly to further improve man-machine interface performance. Implementation of preventive accident management or equivalent design measures to maintain core coolability and pressure vessel integrity after incipience of an event exceeding the design basis. Exploration and elaboration of mitigative accident management measures and/or provision of precautionary design measures to maintain containment integrity even in case of a core melt accident. Implementation of such safety improvements will practically exclude occurrence of a severe accident with unacceptable radiological consequences to the environment.

42762 (IAEA-TECDOC–550, pp. 233-238) **Safety aspects of advanced LWR designs.** Allen, F.R. (UKAEA Safety and Reliability Directorate, Culcheth (UK)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Advanced reactor designs are now being actively pursued in many centres throughout the world for both economic and safety reasons. The Safety and Reliability Directorate of AEA Technology has reviewed these designs to see if they pose any new issues for safety analysis, which will require new methods or data to resolve. In order to identify potential accident sequences in new designs, a generic logical tool for accident sequence identification has been developed. Also, the safety of these designs has been found to rest more on analysis of such natural processes as natural convection. This may call for more detailed models and experimental verification. These apart, no fundamental difficulties have been found. Simplified designs should make it easier to demonstrate the required degree of safety more transparently, and many of the new designs can retain the benefit gained from operating experience with existing plant if the departures from current practice are not too radical. (author). 1 fig.

42763 (IAEA-TECDOC–550, pp. 221-231) **Applicability of advanced safety systems and concepts to large-sized light water reactors.** Yagawa, G. (Tokyo Univ. (Japan)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

NUPEC (Nuclear Power Engineering Test Center) with the sponsorship of MITI (Ministry of International Trade and Industry) started the investigation on advanced safety systems (related to the reactor shutdown, core cooling and fission product retention functions), using a passive system and/or a simplified system. Major objective of this study is to seek the applicability of the advanced safety system concepts to large-sized LWRs of 800-1350 MWe. This paper summarizes the preliminary result of this program consisting of the following: (a) Survey study: Summarization of R and D activities for advanced safety systems in the world; assessment on the surveyed concepts. (b) Conceptual design: Establishment of the conceptual design targets; designing and technical evaluation; reliability evaluation and compatibility evaluation with regulatory guide lines. (c) Extraction of developmental issues and overall assessment. (author). 7 tabs.

42764 (IAEA-TECDOC–550, pp. 255-262) **Safety aspects of U.S.-sponsored ALWR nuclear power plant designs.** Taylor, J.J. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The safety objectives of the Advanced Light Water Reactor (ALWR) Program, sponsored jointly by the Electric Power Research Institute and the U.S. Department of Energy, are defined so as to achieve a factor of 10 improvement in safety over present LWR reactors. The embodiment of this objective in a passively stable 600 MWe pressurized water reactor (PWR) and a boiling water reactor (BWR) designs is summarized. Both these systems utilize passive cooling mechanisms for emergency core cooling and containment cooling rather than active equipment. Some of the key safety features for the passive BWR are: natural circulation at full power, with free surface steam separation; isolation condenser for passive heat removal for RCS and containment; gravity drain emergency cooling; and steam injector. Some of the key safety features for the passive PWR are: natural circulation decay heat removal; gravity-driven ECCS with full-pressure tanks, depressurization, and low-pressure tank; and passive containment cooling. Limitations in measuring the safety of the design and of the plant in operation are associated with common-mode failure, external events, and human reliability inputs. Because of such limitations, claims for significantly greater safety than set by these objectives for the ALWR or any other concept cannot be accurately verified. Utilizing the industrial safety record as a measure is helpful but not adequate. The means of achieving safety at this level and measuring it are sound and consist of probabilistic safety assessment, industrial/regulatory standards, and the "drive for excellence". Even though human reliability cannot be accurately predicted, the strong emphasis is advanced reactor design on human factors and the reduced requirements for rapid operator response in the passively stable reactors significantly reduces the consequences of human error. (author). 8 refs, 3 figs.

42765 (IAEA-TECDOC–550, pp. 349-359) **External events: Earthquakes, fires and floods.** Okrent, D. (California Univ., Los Angeles, CA (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

A subjective perspective will be given of the current state of affairs in the U.S.A. with regard to the treatment of risks to nuclear power plants arising from earthquakes, fires and floods, with relatively brief mention of high winds/tornadoes and transportation accidents. The emphasis will be on existing light-water reactors (LWRs). (author). 13 refs, 2 figs, 5 tabs.

42766 (IAEA-TECDOC–550, pp. 311-325) **Safety aspects of new HTGR designs in the Federal Republic of Germany.** Kroeger, W. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on

safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

High-Temperature Gas-Cooled Reactors (HTGR) with pebble-bed core are under development in Germany, emphasizing inherent safety features to different extents. The small-sized (200 MWt) HTR-MODUL is designed in such a way that even events of extremely low frequency are not detrimental to the public's health mainly because total loss of active decay heat removal does not induce a significant release of fission products. Changes in safety philosophy aiming at improvement of worldwide public acceptance are proposed incorporating limitation of consequences and of maximum releases in case of hypothetical events for which a high potential for fulfillment has become evident for the HTR-MODUL. Nevertheless, the safety attainable with such a 'revolutionary design' may not be put rigourously on a level with absolute safety; specific limitations and aspects have to be faced. (author). 10 refs, 8 figs, 5 tabs.

42767 (IAEA-TECDOC–550, pp. 327-342) **Safety aspects of the modular high-temperature gas-cooled reactor (MHTGR).** Silady, F.A. (General Atomics, San Diego, CA (USA)); Millunzi, A.C. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The Modular High-Temperature Gas-Cooled Reactor (MHTGR) is an advanced reactor concept under development through a cooperative program involving the U.S. Government, the nuclear industry and the utilities. Near-term development is focused on electricity generation and cogeneration uses such as water desalination. The design utilizes the basic high-temperature gas-cooled reactor (HTGR) features of ceramic fuel, helium coolant, and a graphite moderator. However, the specific size and configuration are selected to utilize the natural characteristics of these materials to develop a significantly higher margin of safety than current generation reactors. The qualitative top-level safety requirement is that the plant's operation not disturb the normal day-to-day activities of the public. Quantitatively this requires that the design meet the U.S. Environmental Protection Agency's Protective Action Guides at the site boundary hence precluding the need for sheltering or evacuation of the public. The MHTGR safety response to events challenging the functions relied on to retain radionuclides within the coated fuel particles has been evaluated. A broad range of challenges to core heat removal have been examined which include a loss of helium pressure and a simultaneous loss of forced cooling of the core. The challenges to control of heat generation have considered not only the failure to insert the reactivity control systems, but the withdrawal of control rods. Finally, challenges to control chemical attack of the ceramic coated fuel have been considered, including catastrophic failure of the steam generator allowing water ingress or of the pressure vessels allowing air ingress. The plant's response to these extreme challenges is not dependent on operator action and the events considered encompass conceivable operator errors. (Abstract Truncated)

42768 (IAEA-TECDOC–550, pp. 505-514) **Containment design for severe accidents: Defense of containment basemat integrity against corium attacks.** Turrichia, A. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

A device intended to prevent the attack of the molten corium on the containment basemat, in case of a severe accident, is described. It consists of a flooded stack of staggered stainless steel beams located in an enlarged cavity below the reactor pressure vessel. (author). 5 refs, 7 figs.

42769 (IAEA-TECDOC–550, pp. 575-587) **Safety recommendations for advanced reactors in the Netherlands.** Eendebak, B.T. (Joint Labs. and Other Services of the Dutch Electricity Supply Companies, Arnhem (Netherlands)); Speelman, J.E.; Heil, J.A. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Following the Chernobyl accident, the Dutch authorities deferred decision on construction of two nuclear power plants and announced a series of post-Chernobyl studies. These studies have been finalized, and are under discussion in several governmental advisory committees. One of the studies concerns the source term achievable for nuclear power plants to be built in the near future. This source term study (performed by ECN) was based on the results of recent PRA's and on possible effects of severe accident management measures. The most important recommendations of the source term study are: The core melt frequency should be less than 10^{-5} per reactor year; The relation between release magnitude and probability satisfies at least the following requirements: the probability is 10^{-6} per reactor year for a relatively small release (viz. Cs,I: 0.1%); the probability is 10^{-8} to 10^{-7} per reactor year for a medium-sized release (viz. Cs,I: 1%); the large releases of more than 10% of the volatile fission products (I,Cs) is ruled out, i.e. the probability of its occurrence is lower than 10^{-9} per reactor year. The source term recommendations lead to a number of requirements for the design specification of the new nuclear power plants. Two important items in this discussion concern: the consequences for the design specification of new nuclear power plants and the modifications necessary to fulfil the additional requirements; the role that inherent and passive safety features play in the design of nuclear plants and the way these features are affected by the existing legal framework. Presently KEMA participates in the EPRI programme on advanced reactors. A major contribution is the availability of the Dodewaard nuclear power plant. This plant is a 65 MWe natural circulation boiling water reactor that already exhibits many safety features as proposed for advanced reactors. (Abstract Truncated)

42770 (IAEA-TECDOC–550, pp. 515-534) **Terminology for future nuclear power plants.** Lo Prato, E. (Directorate for Nuclear Safety and Health Protection (ENEA/DISP), Rome (Italy)); Petrangeli, G.; Tononi, R.; Zaffiro, C. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The growing interest of the Technical Community and of the Public in advanced nuclear plants designed according to specific

safety principles require the adequacy and consistency - still not well established - of the pertinent terminology. An additional contribution is given by the present paper, useful to better characterize the safety features of advanced future plants: caution in the use of terms such as "inherent safety" and "inherently safe", which require in any case specification of the hazards avoided or eliminated by means of inherent safety features; an enlarged scope of the "passive safety" term, to include systems which perform passively safety functions, but rely for their activation on suitable internal "self-acting" devices; a revised definition of the "grace period" concept, which should point out the correlation between grace period duration and limits of the accident consequences and also take into account the advisability of plant monitoring during the same period; as a consequence, the use of "walkaway safe" should be discouraged. Moreover, the present paper proposed the introduction of the following terms: "inherent and passive safety plant", to define an advanced plant in which the essential safety functions (reactor shutdown, emergency core cooling and F.P.) (Abstract Truncated)

42771 (IAEA-TECDOC–550, pp. 635-643) **Safety of emerging nuclear energy systems: Criteria and ways to meet them.** Novikov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Slesarev, I.S. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The first stage of world nuclear power development based on light water fission reactors has demonstrated not only a rather high rate but at the same time a too optimistic attitude to safety problems. Large accidents at Three Mile Island and Chernobyl essentially affect the concept of NP development. As a result the safety and social acceptance of NP became an absolute priority among other problems. That's why emerging nuclear power systems should be first of all estimated from this point of view. In the paper some quantitative criteria of safety derived from estimations of social risk and economic-ecological damage due to large accidents are formulated. On the basis of this criteria we define enhanced safety NES, ultimate safety NES and asymptotic high safety ENES. The limits of tolerated expenses for safety are regarded. The basic physical factors determining hazards of NES accidents are considered. This permits to classify the ways of safety demands fulfilment due to physical principles used. (author). 3 refs.

42772 (IAEA-TECDOC–550, pp. 645-652) **Summary of the workshop.** Kouts, H.J.C. (Brookhaven National Lab., Upton, NY (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The questions addressed through the Agenda of the Workshop "The Safety of Nuclear Installations of the Next Generation and Beyond" held in Chicago, Illinois, USA, on 28-31 August 1989 have been the following: what might be the type and extent of the future requirement for heightened use of nuclear energy, how must the matter of public concern over safety of nuclear energy be addressed if this technology is to be returned to its previous state of active growth, what lines of development of future types of nuclear plants are being pursued throughout the world that can affect the safety and acceptability of nuclear energy in the decades to come, what associated changes pertaining to safety will be needed in the nuclear field if the challenge is to be met positively.

42773 (INP–1370/PL, pp. 427-432) **Radioactive particles from the Chernobyl fallout in Poland.** Broda, R. (Institute of Nuclear Physics, Cracow (Poland)); Szeglowski, Z.; Zuber, K. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The results of the investigations of the hot radioactive particles present in fallout in Poland after Chernobyl accident are briefly summarized. 6 refs., 2 figs. (M.F.W.).

42774 (INP–1422/B) **Alpha emitters in Chernobyl hot particles.** Broda, R.; Kubica, B.; Szeglowski, Z.; Zuber, K. Institute of Nuclear Physics, Cracow (Poland). Oct 1988. 26p. Order Number DE90635302. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The alpha radioactive component of hot particles from the Chernobyl fallout was analysed for cases studied previously by gamma spectroscopy. Correlations established from the absolute alpha activity determination and high resolution analysis provided information on actinides release during accident and on some aspects of the Chernobyl reactor fuel composition. Unexpected features revealed during the analysis of one specific particle are presented. 11 refs., 5 figs., 5 tabs. (author).

42775 (NUREG–0936-Vol.9-No.2) **NRC regulatory agenda: Quarterly report, April–June 1990: Volume 9, No. 2.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1990. 121p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A08/MF A01 - GPO - OSTI.

The NRC Regulatory Agenda is a compilation of all rules on which the NRC has proposed or is considering action and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The Regulatory Agenda is updated and issued each quarter.

42776 (NUREG/CR–4794) **Experimental results of core-concrete interactions using molten steel with zirconium.** Copus, E.R. (Sandia National Labs., Albuquerque, NM (USA)); Blose, R.E.; Brockmann, J.E.; Gomez, R.D.; Lucero, D.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Jul 1990. 374p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–86-2638). Source: NTIS, PC A17/MF A01 - GPO; OSTI; INIS.

Four inductively sustained experiments, QT-D, QT-E, SURC-3, and SURC-3A, were performed in order to investigate the additional effects of zirconium metal oxidation on core debris-concrete interactions using molten stainless steel as the core debris simulant. The QT-D experiment ablated 18 cm of concrete axially during 50 minutes of interaction on limestone-common sand concrete using a 10 kg charge of 304 stainless steel to which 2 kg of zirconium metal was added subsequent to the onset of erosion. The QT-E experiment ablated 10 cm of limestone-common sand concrete axially and 10 cm radially during 35 minutes of sustained interaction using 50 kg of stainless steel and 10 kg of zirconium. The SURC-3 experiment had a 45 kg charge of stainless steel to which 1.1 kg of zirconium was subsequently added. SURC-3 axially eroded 33 cm of limestone concrete during two hours of interaction. The fourth experiment, SURC-3A, eroded 25 cm of limestone concrete axially and 9 cm radially during 90 minutes of sustained interaction. It utilized 40 kg of stainless steel and 2.2 kg of added zirconium as the charge material. All four experiments showed in a large increase in erosion rate, gas production, and aerosol release following the addition of Zr metal to the melt. In the SURC-3 and SURC-3A tests the measured erosion rates increased from 14 cm/hr to 27 cm/hr, gas release increased from 50 slpm to 100 slpm, and aerosol release increased from .02 g/sec to .04 g/sec. The effluent gas was composed of 80% CO, 10% CO_2, and

2% H_2 before Zr addition and 92% CO, 4% CO_2, 4% H_2 during the Zr interactions which lasted 10–20 minutes. Addition measurements indicated that the melt pool temperature ranged from 1600°C–1800° and that the aerosols produced were comprised primarily of Te and Fe oxides. 21 refs., 120 figs., 51 tabs.

42777 (NUREG/IA–0034) **Assessment study of RELAP5/MOD2 Cycle 36.04 based on pressurizer safety and relief valve tests.** Stubbe, E.J.; Vanhoenacker, L. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; TRACTEBEL, Brussels (Belgium). Jul 1990. 84p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

This report presents a code assessment study based on full size relief and assisted safety valve (called SEBIM) tests performed on the CUMULUS valve test rig operated by Electricite de France (EdF). The increased awareness that the pressuriser safety and relief valves are not reliable under water blowdown conditions, has led to the design, testing and installation of so called assisted safety valves of which the SEBIM (TM) valves are an example. These valves, used in tandem, are gradually replacing the safety and relief valves on pressurisers in some European PWR's. Before installation at the plant, the Belgian safety authorities requested a thorough full scale testing of these valves on a test rig (CUMULUS) equipped with sufficient diagnostics to measure the characteristics of the valve. The Belgian architect-engineering firm TRACTEBEL was called upon the specify, order and test these valves for installation at the DOEL 1 and DOEL 2 power plants. These tests do provide sufficient data of high quality to justify an assessment study of the code RELAP-5 MOD-2 CYCLE 36 in the ICAP framework which is the subject of this report.

42778 (ORNL/FTR–3692) **[Nuclear power plant databases]: Foreign trip report, August 17, 1988–June 30, 1990.** Engle, W.W. Jr. Oak Ridge National Lab., TN (USA). 30 Jul 1990. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90014983. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The assignee completed a 22-1/2 month assignment at the NEA Data Bank providing support for the reactor safety programs of the NEA. Specifically the assignee completed a pilot study for the CSNI Code Validation Matrix, completed a retrieval package for the PC version of the NEA Incident Reporting System, successfully completed the transfer of that project to the NOAC at ORNL, and completed the design and implementation of a database for maintaining current information on all nuclear power plants.

42779 (REG/G–1.35-Rev.3) **Inservice inspection of ungrouted tendons in prestressed concrete containments: Revision 3.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Jul 1990. 7p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A02/MF A01 - GPO - OSTI.

General Design Criterion 53, "Provisions for Containment Testing and Inspection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that the reactor containment be designed to permit (1) periodic inspection of all important areas and (2) an appropriate surveillance program. This guide describes a basis acceptable to the NRC staff for developing an appropriate inservice inspection and surveillance program for ungrouted tendons in prestressed concrete containment structures of light-water-cooled reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

42780 **Transactions of the 10th international conference on structural mechanics in reactor technology: Volume R.** Waste repository technology. Hadjian, A.H. 171p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book covers aspects of engineering mechanics pertaining to mechanical and structural components and the relevant systems in nuclear reactors. A wide spectrum of subjects is covered, including theoretical developments in structural mechanics, loading conditions, behavior of materials, fluid mechanics, operating experience, accident sequences, and calculational procedures. Problems of structural mechanics analysis are focused within the general context of the design, reliability, and safety of nuclear reactors. Operating plant performance and life extension, waste repository technology and regulatory research have been formalized as distinct divisions.

42781 **Transactions of the 10th international conference on structural mechanics in reactor technology: Volume T.** Flow-induced dynamics. Hadjian, A.H. 135p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book covers aspects of engineering mechanics pertaining to mechanical and structural components and the relevant systems in nuclear reactors Subjects covered include theoretical developments in structural mechanics, loading conditions, behavior of materials, fluid mechanics, operating experience, accident sequences, and calculational procedures. Problems of structural mechanics analysis are focused within the general context of the design, reliability, and safety of nuclear reactors. Operating plant performance and life extension, waste repository technology and regulatory research are addressed.

42782 **Transactions of the 10th international conference on structural mechanics in reactor technology: Volume E.** Fast reactor core and coolant circuit structures. Hadjian, A.H. (Bechtel Power Corp., Los Angeles, CA (USA)). 337p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book contains papers on fast reactor core and coolant circuit structures. Topics covered include: thermomechanical studies, design of LMFBR components, and core seismic studies.

42783 **Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J.** Extreme loads analysis. Hadjian, A.H. (Bechtel Power Corp., Los Angeles, CA (USA)). 337p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book contains the transactions of the 10th international conference on structural mechanics in reactor technology, volume J, extreme loads analysis. Topics covered included concrete containments (analysis, testing and design), steel containments (analysis, testing and design), extreme internal events; pressure and thermal loading, and extreme loads on penetrations, piping and components.

42784 **Analytical study of the failure mode and capacity of the Sequoyah containment.** Miller, J.D. (Sandia National Lab., Albuquerque, NM (US)); Clauss, D.B. pp. 91-96 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Sandia National Laboratories has developed analytical techniques for predicting the performance of light water reactor steel containment buildings subject to loads beyond the design basis. The analytical techniques are based on experience with large scale steel containment model tests. Results of the model tests provide insights into the structural response of steel containments and experimental validation of the analytical methods. The methodology for analyzing steel containments has advanced to the point that the NRC asked Sandia to demonstrate these analytical techniques on an actual steel containment building under hypothetical conditions of severe accident loading. The objective of the analysis was to determine the actual pressure capacity and the mode, location,

and size of failure, based on a functional definition of failure. The results are presented.

42785 Aging degradation of BWR reactor internals. Ware, A.G. (EG and G Idaho, Inc., Idaho Falls, ID (USA)). pp. 81-86 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume D. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper reports on an assessment of the aging of the reactor internals in boiling water reactors (BWRs), and identified the unresolved technical issues related to the degradation of these components. Several failures in BWR reactor internals have been caused by a combination of susceptible materials, environment, preload stress, and flow-induced vibration. ASME Code Section XI inservice inspection requirements are insufficient for detecting aging-related degradation in reactor internals. Many of the susceptible locations are not accessible for inspection.

42786 Response of a base-isolated large liquid metal reactor plant to seismic loads. Chang, Y.W. (Argonne National Lab., IL (USA)); Gvildys, J. pp. 91-96 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract W-31-109-ENG-38. (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper deals with the seismic response of a base isolated large-scale LMR plant. The analysis model was based on a preliminary nuclear island layout developed by EPRI during the concept development phase of the large-scale prototype breeder (LSPB) project. The nuclear island has a dimension of 184 ft-0 in x 210 ft-6 in; the reactor vessel has an ID of 62 ft and an overall length of 70 ft. Two soil conditions have been considered in the analysis. One is a hard-soil site having a shear wave velocity of 6000 ft/s, and the other is a soft-soil site having a shear wave velocity of 2000 ft/s. For comparison purposes, the response of a conventional plant (unisolated) was also analyzed.

42787 Approximate solutions for dynamic plastic deformation of a tube. Youngdahl, C.K. (Argonne National Lab., Argonne, IL (US)). pp. 103-108 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper treats the problem of a long tube, loaded by a time-dependent pressure distribution P(z,t) that is applied over a time-dependent region 2L(t). The plastic deformation is a combination of localized circumferential stretching and axial bending of the tube wall, which depend on the history of the applied force F(t) and the applied moment G(t) about z = 0 associated with the pressure distribution. The final plastic deformation depends on an effective applied force F_e, and effective applied moment G_e, and effective length of the loaded region $2L_e$, and the deformation that would be attained if the loading were applied as a pure impulse. All the effective values involve only simple integral of the loading. Consequently, they do not depend on details of the loading functions and eliminate the need for obtaining time-dependent solutions for the deformation. The pure impulse solution depends not only on the value of the applied impulse and an effective length of the loaded region, but also on the pulse shape and the shape of L(t) if the loaded region is growing. Loading applied over a nonzero interval can produce a large deformation that the same impulse applied instantaneously if the loaded region is very narrow and growing.

42788 Remedies for PWR recirculating steam generator tube failures. Shah, V.N. (Idaho National Engineering Lab., Idaho Falls, ID (USA)); Amar, A.S. pp. 189-194 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume D. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract AC07-76ID01570. (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Pressurized water reactor (PWR) steam generator tubes form well over one-half of the primary system pressure boundary and have experienced significant aging degradation of some plants. Tube failures have caused contamination of the secondary coolant by the primary coolant, and radiological releases to the environment when atmospheric relief valves were actuated. Degraded steam generator tubes may fail during a severe accident and allow radioactive material to bypass containment. Simultaneous rupture of several tubes may lead to a major plant temperature and pressure transient with potential impact on the structural integrity of various components in the system. Tube leakages result in unscheduled plant outages when the leakage rate exceeds acceptable limits. Finally, repair and replacement associated with steam generators account for much of the personnel radiation exposure (manrems) at PWR plants. Therefore, industry has developed various remedies for steam generator tube aging. This paper evaluates the effectiveness of current remedies used to reduce aging damage to recirculating type steam generator tubes. Following topics are discussed: degradation mechanisms, mitigation techniques, repair methods, and conclusions and recommendations.

42789 Response of a pool type LMR to seismic loads. Wang, C.Y. (Argonne National Lab., IL (USA)); Gvildys, J. pp. 109-114 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract W-31-109-ENG-38. (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper describes the seismic analysis of a 450-MWe pool-type liquid metal reactor (LMR) under 0.3 g SSE ground excitations. It also assesses the ultimate inelastic structural capabilities for other beyond-design-basis seismic events. Calculation is focused on a new design configuration where the vessel thickness is reduced considerably compared to the previous design. The Argonne National Laboratory augmented three-dimensional Fluid-Structure Interaction program, FLUSTR-ANL is utilized for performing the base calculation where ground excitation is assumed to be 0.3 g SSE. The Newmark-Hall Ductility modification method was used for the beyond-design-basis seismic events. In both calculations, stress fields generated from the horizontal and vertical excitations are evaluated separately. The resultant stresses due to combined actions of these events are computed by the SRSS method.

42790 Three-dimensional bowing analysis of radial reflector assemblies in advanced LMRS. Kamal, S. (Argonne National Lab., IL (USA)). pp. 163-168 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract W-31-109-ENG-38. (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The near-core radial shield in some advanced liquid metal fast reactors (LMRs) consists of steel reflector assemblies that surround the inner core assemblies followed by shield assemblies that have large volume fraction of boron carbide. The reflector and shield assemblies of these reactors are removable, similar in outer configuration to the inner core assemblies and link the inner assemblies to the outer parts of the core restraint system. An important design goal for these reflector and shield assemblies is to have the longest service life in the core with minimum handling. Extended residence of the reflector assemblies in particular, with the ducts subjected to large neutron flux gradients, could give rise to relatively large differential irradiation-induced swelling strains, duct inelastic deformations and inter-assembly forces. The purpose of this paper is to assess the effect of extending the residence of reflector assemblies in view of the mechanical design requirements of LMR cores.

42791 Analysis of fluid-structure interaction and structural response of Chernobyl-4 reactor. Wang, C.Y. (Argonne National Lab., IL (USA)); Pizzica, P.A.; Gvildys, J.; Spencer, B.W. pp. 109-120 of Transactions of the 10th international conference on

structural mechanics in reactor technology: Volume T. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The accident at Chernobyl-4 occurred during the running of a test to determine the turbogenerator's ability to provide in-house emergency power after shutting off its steam supply. The accident was the result of a large, destructive power excursion. This paper presents an analysis of the energetic events associated with the fuel failures, fuel-coolant thermal interactions, and the fluid-structure interaction.

42792 Structural aging program to assess the adequacy of critical concrete components in nuclear power plants. Naus, D.J. (Oak Ridge National Lab., TN (USA)); Marchbanks, M.F.; Oland, C.B.; Arndt, E.G. pp. 201-212 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume D. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract AC05-84OR21400. (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The structural aging (SAG) program is carried out by the Oak Ridge National Laboratory (ORNL) under sponsorship of the United States Nuclear Regulatory Commission (USNRC). The program has evolved from preliminary studies conducted to evaluate the long-term environmental challenges to light-water reactor safety-related concrete civil structures. An important conclusion of these studies was that a damage methodology, which can provide a quantitative measure of a concrete structure's durability with respect to potential future requirements, needs to be developed. Under the SAG program, this issue is being addressed through: establishment of a structural materials information center, evaluation of structural component assessment and repair technologies, and development of a quantitative methodology for structural aging determinations. Progress to date of each of these activities is presented as well as future plans.

42793 Full scale aircraft impact test for evaluation of impact forces-Part 1: Test plan, test method, and test results. Von Riesemann, W.A. (Sandia National Lab., Albuquerque, NM (US)); Parrish, R.L.; Bickel, D.C.; Heffelfinger, S.R.; Muto, K.; Sugano, T.; Tsubota, H.; Koshika, N.; Suzuki, M.; Ohrui, S. pp. 285-293 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper describes a test conducted at an existing rocket sled facility in which an actual F-4 Phantom aircraft was impacted at a nominal velocity of 215 m/s into an essentially rigid block of concrete. This was accomplished by supporting the F-4 on four struts that were attached to the sled track by carriage shoes to direct the path of the aircraft. Propulsion was accomplished by two stages of rockets. The concrete target was floated on a set of air bearings. Data acquisition consisted of measurements of the acceleration of the fuselage and engines of the F-4, and measurements of the displacement, velocity and acceleration of the concrete target. High-speed photograph recorded the impact process and also permitted the determination of the impact velocity. This paper describes the test plan, method and results.

42794 Full-scale aircraft impact test for evaluation of impact force-Part 2: Analysis of the results. Muto, K. (Muto Institute of Structural Mechanics, Inc., Tokyo (JP)); Sugano, T.; Tsubata, H.; Kasai, Y.; Koshika, N.; Suzuki, M.; Ohrui, S.; Von Riesemann, W.A.; Bickel, D.C.; Parrish, R.L. pp. 293-300 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper analyzes measurements used to evaluate the impact force of a rigid barrier against head on impacting aircraft. The authors uses the results to evaluate existing analytical methods for prediction of the impact force.

42795 Experimental studies on local damage of reinforced concrete structures by the impact of deformable missiles-Part 3: Full scale tests. Muto, K. (Muto Institute of Structural Mechanics, Inc., Tokyo (JP)); Sugano, T.; Tsubota, H.; Nagamatsu, N.; Koshika, N.; Okano, M.; Suzuki, K.; Ohrui, S.; Von Riesemann, W.A.; Bickel, D.C.; Parrish, R.L.; Tachaw, R.D.W. pp. 271-278 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper reports on experimental program for evaluating the local damage caused by a deformable missile, six high-speed full-scale impact tests wee conducted to determine the physical damage to and the dynamic response of reinforced concrete panels when they are subjected to the impact of a full-scale aircraft engine traveling at a velocity of 215 m/s. This impact velocity corresponds to the highest level of the velocities that were used in the scale tests.

42796 Pressure loadings of Soviet designed VVER reactor release mitigation structures from large break LOCAs. Sienicki, J.J. (Argonne National Lab., Argonne, IL (US)); Horak, W.C. pp. 319-324 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper calculates the time dependent pressure loadings inside the accident localization or containment structures of VVER (Water cooled, water moderated energy reactor) reactors. Immediately following the double-ended guillotine rupture of a primary coolant pipe. The pressures are compared with the results of calculations of the response of the structures to overpressure.

42797 Response of Soviet designed VVER-440 steam generator vessel to pressurization. Kennedy, J.M. (Argonne National Lab., Argonne, IL (US)); Sienicki, J.J. pp. 325-330 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper investigates the consequences of manifold failure for the case of the VVER-440 reactor system. An analysis has been performed of the loadings upon and the mechanical response of the steam generator shell for the case of a postulated large break in the manifold wall. The objectives were to calculate the maximum pressure attained inside the shell and to predict the shell failure pressure as well as the failure mechanism.

42798 Response of Soviet VVER-440 accident localization systems to overpressurization. Kulak, R.F. (Argonne National Lab., Argonne, IL (US)); Fiala, C.; Sienicki, J.J. pp. 331-336 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Complex, three-dimensional, nonlinear, finite element models were developed to represent the major structural components of the localization systems of the VVER-440 model V230 and of the VVER-440 model V213. The interior boundary of the localization system was incrementally pressurized in the calculations until the prediction of gross failure.

42799 Impact of insufficient energy content in the design time history on the structure response. Ma, D.C. (Argonne National Lab., IL (USA)); Gvildys, J.; Chang, Y.W.; Seidensticker, R.W. pp. 349-354 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract W-31-109-ENG-38. (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

In the design of nuclear power plants, it is often desirable to use the time history method in the soil-structure interaction analysis to determine the plant floor response to seismic loads. Because many design criteria are specified in terms of design response spectra, the artificial time history needs to be generated under the requirement that the response spectra of the artificial history should envelop the given design response spectra. However, recent studies indicate that the artificial time history used in the plant design may have insufficient energy in the frequency range of interest, even though the response spectra of the design time history closely envelop the design response spectra. This paper presents an investigation of the effects of the insufficient energy content in the design time history on the response of the soil-structure system. Numerical studies were carried out. Both the real earthquake records and the artificial time histories were used as the input motions in a simple lumped-mass soil-structure interaction model. The results obtained from this study provide a better understanding of the effects of the insufficient energy content in the design time history on the structural response.

42800 Integrated system for seismic evaluations. Xu, J. (Brookhaven National Lab., Upton, NY (USA)); Philippacopoulos, A.J.; Miller, C.A.; Costantino, C.J.; Graves, H. pp. 385-390 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper describes the various features of the seismic module of the CARES system (computer analysis for rapid evaluation of structures). This system was developed to perform rapid evaluations of structural behavior and capability of nuclear power plant facilities. The CARES is structural in a modular format. Each module performs a specific type of analysis i.e., static or dynamic, linear or nonlinear, etc. This paper describes the features of the seismic module in particular. The development of the seismic modules of the CARES system is based on an approach which incorporates major aspects of seismic analysis currently employed by the industry into an integrated system that allows for carrying out interactively computations of structural response to seismic motions. The code operates on a PC computer system and has multi-graphics capabilities.

42801 An overview of an experimental program for testing large reinforced concrete shear walls. Farrar, C.R. (Los Alamos National Lab., NM (USA)); Bennett, J.G. pp. 461-466 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper reports on the seismic Category I structures program being carried out at the Los Alamos National Laboratory. In the class of structure being investigated, the primary lateral load-resisting structural element is the reinforced concrete shear wall. Previous results from microconcrete models indicated that these structures responded to seismic excitations with initial frequencies that were reduced by factors of 2 or more over those calculated based on an uncracked cross-section strength-of-materials approach. Furthermore, though the structures themselves were shown to have sufficient reserve margins, the equipment and piping are designed to response spectra that are based on uncracked cross-sectional member properties, and these spectra may not be appropriate for actual building responses. The current phase of the program is aimed at verification of these conclusions using conventional concrete structures to demonstrate that previous microconcrete results can be scaled to prototype structures.

42802 Seismicity and seismic response of the Soviet-designed VVER reactor plants. Ma, D.C. (Argonne National Lab., IL (USA)); Gvildys, J.; Wang, C.Y.; Spencer, B.W.; Sienicki, J.J.; Seidensticker, R.W.; Purvis, E.E. pp. 437-442 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

On March 4, 1977, a strong earthquake occurred at Vrancea, Romania, about 350 km from the Kozloduy plant in Bulgaria. Subsequent to this event, construction of the unit 2 of the Armenia plant was delayed over two years while seismic features were added. On December 7, 1988, another strong earthquake struck northwest Armenia about 90 km north of the Armenia plant. Extensive damage of residential and industrial facilities occurred in the vicinity of the epicenter. The earthquake did not damage the Armenia plant. Following this event, the Soviet government announced that the plant would be shutdown permanently by March 18, 1989, and the station converted to a fossil-fire plant. This paper presents the results of the seismic analyses of the VVER (water-cooled, water-moderated energy reactor) plants. Also presented is information concerning seismicity in the regions where VVERs are located and information on seismic design of VVERs.

42803 Seismic responses of a pool-type fast reactor with different core support designs. Wu, T.S. (Argonne National Lab., IL (USA)); Seidensticker, R.W. pp. 503-508 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

In designing the core support system for a pool-type fast reactor, there are many issues which must be considered in order to achieve an optimum and balanced design. These issues include safety, reliability, as well as costs. Several design options are possible to support the reactor core. Different core support options yield different frequency ranges and responses. Seismic responses of a large pool-type fast reactor incorporated with different core support designs have been investigated.

42804 Investigation of seismic limit states for LWR containments. Clauss, D.B. (Sandia National Labs., Albuquerque, NM (USA)); Von Riesemann, W.A.; Costello, J.F. pp. 509-514 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The investigation described in this paper represents an attempt to quantify the behavior of containment buildings for seismic loading greater than the design safe- shutdown earthquake, or SSE. In this investigation, load combinations well beyond the original design basis were considered. The results are interpreted in the context of generic seismic hazard curves, which are subject to large uncertainty, especially for the strong ground motion corresponding to levels beyond the SSE. Therefore, careful exercise of engineering judgement is required to evaluate seismic threat.

42805 Improved analytical models for PWR safety analysis. Hochreiter, L.E. (Westinghouse Electric Corp. (US)); Paik, C.Y.; Young, M.Y.; Kelly, J.M. pp. 617-665 of Transient phenomena in multiphase flow. Afgan, N.H. Hemisphere Publishing, New York, NY (USA) (1988).

This paper describes the component models for spacer grids, and single phase convective enhancement by two phase dispersed

flow, and shows the comparison of COBRA- TF to rod bundle reflood data.

42806 Response of HDR-VKL piping system to seismic test excitations: Comparison of analytical predictions and test measurements. Srinivasan, M.G. (Argonne National Lab., IL (USA)); Kot, C.A.; Hsieh, B.J. pp. 751-756 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

As part of the earthquake investigations at the HDR (Heissdampfreaktor) test facility in Kahl/Main, FRG, simulated seismic tests (SHAM) were performed during April-May 1988 on the VKL (Versuchskreislauf) piping system. The purpose of the SHAM tests was to study the behavior of piping subjected to a range of seismic excitation levels including those that exceed design levels many times and might induce failure of pipe supports of plasticity in the pipe runs, and to establish seismic margins for piping and pipe supports. Data obtained in the tests are also used to validate analysis methods. The objective of the work reported is to evaluate a subsystem analysis module of the SMACS code. This module is a linear, finite-element-based program capable of calculating the response of nuclear power plant subsystems subjected to independent multiple- acceleration input excitation. The evaluation is based on a comparison of computational results of simulated SHAM tests with corresponding test measurements.

42807 Consistent natural phenomena design and evaluation guidelines for U.S. Department of Energy facilities. Murray, R.C. (Lawrence Livermore National Lab., CA (USA)); Short, S.A. pp. 817-822 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Uniform design and evaluation guidelines for protection against natural phenomena hazards such as earthquakes, extreme winds, and flooding for facilities at Department of Energy (DOE) sites throughout the United States have been developed. The guidelines apply to design of new facilities and to evaluation or modification of existing facilities. These guidelines are an approach for design or evaluation for mitigating the effects of natural phenomena hazards. These guidelines are intended to control the level of conservatism introduced in the design/evaluation process such that all hazards are treated on a reasonably consistent and uniform basis and such that the level of conservatism is appropriate for facility characteristics such as importance, cost, and hazards to on-site personnel, the general public, and the environment. The philosophy and goals of these guidelines are covered by this paper.

42808 Using reliability techniques to investigate pipe breaks caused by seismically-induced support failures. Lo, T.Y. (Lawrence Livermore National Lab., CA (USA)); Holman, G.S. pp. 935-940 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Based on the origin of failure, the study of piping reliability during an earthquake has been divided into two parts: the direct and the indirect pipe failures (either a leak or a double-ended guillotine break (DEGB)). Direct pipe failure is defined as pipe failure caused by the growth and instability of existing cracks in the piping system. Cracks grow during the lifetime of a piping system and may become unstable due to seismically-induced stresses. Indirect pipe failure is due to failure of other structures or components, which in turn cause the pipe to fail. One major indirect source is earthquake-generated missiles, such as falling objects. The other major source of indirect pipe failure is the failure of pipe and component supports. That is, and earthquake can cause the support to fail first, and this failure breaks the pipe. In reality, direct and indirect pipe failure can be closely related because the pipe can fail due to crack growth and instability (direct source) induced by the stress conditions caused by missile and/or support failure (indirect source). A formulation for comprehensive probabilistic analysis of the seismically induced pipe failure is presented.

42809 Relay testing: Parametric investigation of seismic fragility. Bandyopadhyay, K.K. (Brookhaven National Lab., Upton, NY (USA)); Hofmayer, C.H.; Kassir, M.; Pepper, S. pp. 911-916 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The seismic capacity of most electrical equipment is governed by malfunction of relays. An evaluation of the existing relay test data base at Brookhaven National Laboratory (BNL) has indicated that the seismic fragility of a relay may depend on various parameters related to the design or the input motion. In particular, the electrical mode, contact state, adjustment, chatter duration acceptance limit, and the frequency and the direction of the vibration input have been considered to influence the relay fragility level. For a particular relay type, the dynamics of its moving parts depends on the exact model number and vintage and hence, these parameters may also influence the fragility level. In order to investigate the effect of most of these parameters on the seismic fragility level, BNL has conducted a relay test program. The testing has been performed. Establishing the correlation between the single frequency fragility test input and the corresponding multifrequency response spectrum (TRS) is also an objective of this test program. This paper discusses the methodology used for testing and presents a brief summary of important test results.

42810 The high flux isotope reactor Oak Ridge National Laboratory: Seismic, high wind, tornado, and probabilistic risk assessments. Harris, S.P. (EQE, Inc., San Francisco, CA (USA)); Hashimoto, P.S.; Stover, R.L. pp. 959-964 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume K1-K2. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855--: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

The high flux isotope reactor (HFIR) is a high-power density research reactor operating to a maximum of 85 MW (th). The high thermal neutron flux achieved in perform neutron scattering research. In late 1986, an effort was initiated to evaluate the effects of neutron radiation on the integrity of the HFIR reactor vessel. Shortly thereafter a general reassessment of the design and operation of the facility was initiated under the direction of the U.S. Department of Energy (DOE). HFIR was designed, constructed, and began operation more than 20 years ago. During this period, the nuclear community developed and implemented a large body of codes and practices that were not part of this facility design. This paper reports on the performance of deterministic, seismic, high wind, and tornado analyses, and probabilistic risk assessments utilizing an earthquake experience data base and evaluation methods developed to assess the seismic adequacy of vintage facilities.

42811 A new safety approach in the design of fast reactors. Neuhold, R.J. (USDOE Germantown, NE-472, Washington, DC (US)); Marchaterre, J.F.; Waltar, A.E. *Nuclear Technology (USA)*, 89(1): 83-91 (Jan 1990).

The authors discuss how anew approach to achieving fast reactor safety goals is becoming apparent in the U.S. Fast Reactor Program. Whereas the defense-in-depth philosophy still prevails, there has been a tangible shift toward emphasizing passive mechanisms to protect the reactor and provide public safety rather than relying on add-on active, engineered safety systems. Intrinsic reactivity feedback mechanisms, based on fundamental nuclear cross section and material motion changes with temperatures, combined with passive methods to assure removal of decay heat, are being quantified and included in analysis techniques to demonstrate the

exceptional robustness of current advanced liquid-metal-cooled reactor designs in the United States.

42812 Estimating the financial consequences of a severe nuclear accident in Canada. Lonergan, S.C. (Victoria Univ., BC (Canada). Dept. of Geography); Goble, R.L.; Cororaton, C. *Energy (Oxford) (UK)*, 15(6): 507-522 (Jun 1990).

The offsite financial consequences of a severe accident at the Pickering Nuclear Generating Plant in Pickering, Ontario, are estimated with use of the Melcor Accident Consequence Code System (MACCS) developed at Sandia National Laboratories (Albuquerque, NM). Although the consequences of an accident have implicitly been included in developing the Canadian Nuclear Liability Act, no detailed study of these consequences has ever been conducted except by Ontario Hydro, a public utility and a branch of the Ontario Ministry of Energy with responsibility for nuclear power planning and development in the province of Ontario. The MACCS model was adapted to the southern Ontario case and run over a range of weather and source-code scenarios for a region with a 100 km radius around Pickering. Estimates were made of the health and property-damage consequences of an accident under these scenarios, with varying evacuation and dose threshold assumptions. While the results show a wide range of possible damages, they indicate that the liability limits set in the Nuclear Liability Act may be too low. (author).

42813 AP600: A simplified, passive APWR plant design. Bruschi, H.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear and Advanced Technology Div.); Bruce, R.A.; Vijuk, R.P. *Proceedings of the American Power Conference (USA)*, 51: 672-678 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper reports on the AP600, a greatly simplified 600 MWe pressurized water reactor (PWR) plant with major improvements in safety, operability, maintainability, life cycle cost, and construction schedule, compared to existing nuclear plants. In 1985, the Electric Power Research Institute (EPRI) initiated a program to investigate the potential for small ({ <=} 600 MWe) innovative advanced light water reactor (ALWR) plants. As part of this program, a conceptual design for a 600 MWe PWR plant featuring a simplified reactor coolant loop, passive safeguards systems, and modular construction was developed. This concept was based on an earlier conceptual design of a 10 MWe PWR plant with similar features, which was developed to provide a secure power source for military installations. In 1986, the U.S. Department of Energy (DOE) initiated technology programs in support of ALWR's, including a program on the advanced passive 600 MWe PWR plant concept which has been developed into the AP600 plant described here.

24 POWER TRANSMISSION AND DISTRIBUTION

42814 (N–90-21795) **Free-space power transmission.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. 189p. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). Source: NTIS, PC A09/MF A02.

NASA Lewis Research Center organized a workshop on technology availability for free-space power transmission (beam power). This document contains a collection of viewgraph presentations that describes the effort by academia, industry, and the national laboratories in the area of high-frequency, high-power technology applicable to free-space power transmission systems. The areas covered were rectenna technology, high-frequency, high-power generation (gyrotrons, solar pumped lasers, and free electron lasers), and antenna technology.

42815 (N–90-21795, pp. 19-35) **Millimeter wavelength rectenna development.** Gallagher, J.; Gouker, M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

Rectennas were studied with the intent of converting the Earth's (black body) radiation into dc power for satellites in earth orbit. Power densities; metal-oxide-metal diodes; antenna design configurations; fluid patterns; substrate mounted antennas; and directions for future work are outlined. This presentation is represented by viewgraphs only.

42816 (N–90-21795, pp. 67-96) **Free electron lasers driven by linear induction accelerators: High power radiation sources.** Orzechowski, T.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

The technology of Free Electron Lasers (FELs) and linear induction accelerators (LIAs) is addressed by outlining the following topics: fundamentals of FELs; basic concepts of linear induction accelerators; the Electron Laser Facility (a microwave FEL); PALADIN (an infrared FEL); magnetic switching; IMP; and future directions (relativistic klystrons). This presentation is represented by viewgraphs only.

42817 (N–90-21795, pp. 97-114) **Analysis of a high harmonic rectangular gyrotron using ribbon beams.** Ferendeci, A.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

Cylindrical cavity structures and electron orbits; a grooved gyrotron using a ribbon beam; construction details; radiation patterns; radiation distribution; phase distribution; energy curves; and advantages are outlined. This presentation is represented by viewgraphs and charts only.

42818 (N–90-21795, pp. 115-125) **Operation of a step tunable megawatt gyrotron.** Kreischer, K.E.; Temkin, R.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

An electron cyclotron resonance maser; gyrotron fundamental oscillator; advantages of gyrotrons; a schematic of the experiment; gyrotron design theory; 1 MW design parameters; compact ignition tokamak; and a gyrotron with quasi-optical output coupler are briefly presented. This presentation is represented by viewgraphs only.

42819 (N–90-21795, pp. 137-152) **Solar-pumped laser for free space power transmission.** Lee, J.H. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

Laser power transmission; laser systems; space-borne and available lasers; 2-D and 1 MW laser diode array systems; technical issues; iodine solar pumped laser system; and laser power transmission applications are presented. This presentation is represented by viewgraphs only.

42820 (N–90-21795, pp. 153-157) **High power millimeter wave source development program.** George, T.V. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Nov 1989. (NASA-CP–10016;E–4161;NAS–1.55:10016;CONF-8803271–: Free-space power transmission workshop, Cleveland, OH (USA), 29-30 Mar 1988). In *Free-space power transmission.* Source: NTIS, PC A09/MF A02.

High power millimeter wave sources for fusion program; ECH source development program strategy; and 1 MW, 140 GHz gyrotron experiment design philosophy are briefly outlined. This presentation is represented by viewgraphs only.

2401 Power Systems

Refer also to citation(s) 42827, 42829, 42830, 43140

42821 Applications software for modeling distribution automation operations on the Athens Utilities Board. Patton, J.B. (Oak Ridge National Lab., TN (USA). Energy Div.); Rizy, D.T.; Lawler, J.S. *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA)*, 5(2): 1019-1025 (Apr 1990). DOE Contract AC05-84OR21400.

This paper discusses the development of applications software called the System Reconfiguration Analysis Program (SYSRAP) for modeling distribution automation operations on the Athens Utilities Board (AUB). The first phase of development involved the testing of algorithms that combine a radial power flow analysis, short- circuit analysis and data base structuring of input and calculated values in a data base management program. In the second phase, the algorithms were written in a Pascal program and feeder data was dynamically allocated to system memory to speed computation and access time. During the last phase of development, the program was linked with the real-time data monitored by the distribution automation system at AUB so that SYSRAP could model the real-time behavior of the distribution system as closely as possible. The paper discusses the data base techniques that SYSRAP uses to speed up data base access and computation time and the data requirements for modeling the real-time operation of an electric distribution system.

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 42837

42822 (DOE/CE/34025–T4) **Further studies of 60 Hz exposure effects on human function: Quarterly report No. 4, April 1, 1990–June 30, 1990.** Graham, C. Midwest Research Inst., Kansas City, MO (USA). 20 Jul 1990. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE34025. Order Number DE90014377. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Public concern has been expressed about possible health risks arising from exposure to the electric and magnetic fields generated by power distribution systems. This project is addressing this concern through a laboratory research program designed to evaluate the effects of brief exposure to known field conditions on multiple measures of human function. In this continuation effort, a series of exploratory studies are being performed, which will be followed by a confirmatory experiment, to determine if the above physiological effects differ as a function of exposure to the electric and magnetic fields separately and combined, time of day, and rate of intermittent exposure. Project status to date is as follows. Funds were awarded in the last reporting period to continue this research activity at a reduced level until December 31, 1990. An initial series of exploratory studies, involving 24 healthy male volunteers exposed over multiple sessions, has been completed. These studies assessed whether effects on human physiology differ over the day as a function of intermittent exposure to the electric versus the magnetic fields. Exposure to the magnetic fields produced a pattern of cardiac changes similar to that observed in our previous research. This pattern was not found when subjects were exposed to the electric field. During this reporting period our goals were to: continue performance of the "probe" studies; and present project findings at the 1990 meeting of the Bioelectromagnetics Society (BEMS).

42823 (EPRI-EL–6923) **HVDC wall bushing studies: Final report.** Schneider, H.M. (General Electric Co., Lenox, MA (USA)); Lux, A.E.; Howes, D.R. Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., Lenox, MA (USA). ©Jul 1990. 120p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes research conducted to determine the performance of HVDC wall bushings in different wetting conditions. The in-service behavior of these wall bushing on HVDC systems at voltages of ±450 kV and above is first described to establish the conditions under which flashovers have occurred. Laboratory tests made at the EPRI High Voltage Transmission Research Center confirm that wall bushings may flash over at rated operation voltage under conditions which are intended to be representative of those experienced on operating transmission systems. Methods for improving performance are discussed, and results of tests with several types of mitigation techniques are described. The major emphasis is placed on the application of room temperature vulcanized (RTV) silicone rubber. Clean fog is used to evaluate the characteristics of this material on post insulators. The encouraging performance of the post insulators coated with RTV is the basis for further evaluation on full scale wall bushings tested in nonuniform rain. In addition to tests on RTV coated wall bushings without predoposited contamination, attempts at achieving reasonable contamination layers on RV are described. By means of resistance measurements on horizontal insulators, the critical conditions which may lead to flashover on surfaces with different materials and coatings are investigated 15 refs., 39 figs., 11 tabs.

42824 (LUTFD2-TFRT–1032-1-155-1990) **Damping of power oscillations in large power systems.** Eliasson, B. Lund Univ. (Sweden). Dept. of Automatic Control. Jan 1990. 154p. Order Number DE90512631. Source: NTIS (US Sales Only), PC A08/MF A01.

Much research has been done during the last twenty years about tuning of damping equipment in power systems. Damping equipment of concern in this thesis are PSSs (Power System Stabilizers), SVCs (Static Var Compensators), and HVDC (High Voltage Direct Current) links. A large number of design techniques have been presented, from conventional SISO-design (Single Input-Single Output), root-loci design to modern techiques such as LQ-design and MIMO-techiques. Unfortunately, the existing control design techniques cannot cope with large power systems, which models typically have more than 2000 states. Another important feature, which seldom is included in the models or the design procedures, is the characteristics of the load. Especially the voltage dependence of the load has a major impact on the performance and tuning of parameters concerning the PSSs and the SVCs. The frequency dependence of the load becomes important for the HVDC links. This thesis focuses on four major topics: * Modeling of a large power system with respect to slow oscillations (two states/generator); * Aggregation of large systems with preservation of the slow dynamics; * Finding proper feedback structures for the different damping equipment for the siting and tuning analysis; * Formulation of an optimization problem for tuning of control parameters applicable to damping equipment in a large power system. Only slow and system wide modes are of concern in this thesis, i.e. modes with a frequency less than about 0.8 Hz. Faster modes are rather well damped due to the damper windings in the generators. At the most a three state concept for damping is enough. For slow modes, though, a two state concept is enough, which is also pointed out in this thesis. The optimization problem is tested for 200 parameters and the tuning works well. This amount of parameters covers the need of tuning of slow modes in a large power system.

42825 (LUTFD2-TFRT–3201-1-103-1989) **Power system stabilizers in multimachine systems.** Akke, M. Lund Univ. (Sweden). Dept. of Automatic Control. Feb 1989. 104p. Order Number DE90512590. Source: NTIS (US Sales Only), PC A06/MF A01.

Self-excited low frequency power osicllations in large electric systems are a phenomenon, which have caused considerable problems by jeopardizing the operation of the systems. The Scandinavian power grid has had some serious incidents with power oscillations between, for example, southern Finland and southern Norway. This thesis focuses on how to use power system stabilizers (PSS) to damp oscillations in large power systems. The problem of applying and tuning power system stabilizers is approached using multivariable control theory. The control problem is decompsed into the three topics, modelling, finding feedback structure and tuning of the controller. A multimachine model siutable for design is presented. The design method is based on linear quadratic (LQ) regulator design. A new method to find a sparse feedback structure, which captures importants parts in a good control law, is presented. The feedback structure is not restricted, as it has traditionally been, to only local measurements. Two methods for tuning of a prametrized controller are discussed and exemplified. Finally, a design example for a 16 machine power systems is shown. (33 figs., 2 tabs., 48 refs.).

42826 (NISTIR–4339) **Research for electric energy systems: An annual report.** Van Brunt, R.J. (ed.). National Inst. of Standards and Technology (NML), Gaithersburg, MD (USA). Electricity Div. Jun 1990. 83p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-87CE34011. Order Number DE90014221. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report documents the technical progress in four investigations which make up the project "Support of Research Projects for Electrical Energy Systems," funded by the US Department of Energy and performed by the Electricity Division of the National Institute of Standards and Technology (NIST). Specifically these investigations include: (1) an evaluation and critique of techniques for measuring ambient magnetic fields in support of epidemiological and in vitro studies of biological field effects; (2) development of techniques for detecting the toxic gas S_2F_{10} in SF_6 and measuring its production rate from corona discharges in SF_6; (3) optical and electrical measurements of prebreakdown partial-discharge phenomena in dielectric liquids; and (4) development of improved electro-optical methods for measurement and characterization of fast, transient high-voltage impulses. The work discussed in this report is part of an ongoing research activity at NIST. 95 refs., 41 figs., 3 tabs.

42827 Degree of corona saturation for HVDC transmission lines. Johnson, G.B. (General Electric Co., Lenox, MA (USA). High Voltage Transmission Research Center). *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA),* 5(2): 695-707 (Apr 1990).

The dc electric field and ion density are two of the electrical quantities of interest that characterize the electrical environment of HVDC transmission lines. This paper presents an overview of the electric field and ion environment of HVDC transmission lines and introduces the concept of degree of corona saturation. By using the degree of corona saturation along with the electrostatic (corona free) and corona saturated conditions as lower and upper limits, the dc electric field and ion density can be simply and quickly calculated for a variety of weather conditions and line configurations.

2403 Power Transmission Lines and Cables

Refer also to citation(s) 42829

42828 Coaxial cable cutter. Hall, L.C.; Hedges, R.S. To Dept. of Energy, Washington, DC. USA Patent 4914818/A/. 10 Apr 1990. Filed date 23 Aug 1988. USA Patent Application 7-235,079. Int. Cl. H02G 1/12. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A cutting device is presented which is useful in trimming the jackets from semi-rigid coaxial cables and wire having a cutting bit and support attached to movable jaws. A thumbpiece is provided to actuate the opening of the jaws for receiving the cable to be trimmed, and a spring member is provided to actuate the closing of the jaws when thumbpiece is released. The cutting device utilizes one moving part during the cutting operation by using a rolling cut action. The nature of the jaws allows the cutting device to work in space having clearances less than 0.160 inches.

2404 Health and Safety

Refer also to citation(s) 42822, 42826

2405 Environmental Aspects

Refer also to citation(s) 42826, 42827

42829 The effects of steep-front, short-duration impulses on power distribution components. Miller, D.B. (Mississippi State Univ., Mississippi State, MS (USA)); Lux, A.E.; Grzybowski, S.; Barnes, P.R. *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA),* 5(2): 708-715 (Apr 1990). DOE Contract AC05-84OR21400.

A line type pulser has been developed to test the effects of steep-front, short duration (SFSD) pulses on distribution components. Risetime is 50-100 ns, and pulse duration is on the order of 300 ns. Terminators often shattered or punctured rather than flashing over. Insulator flashover voltage is approximately 1.5 times CFO for standard lightning impulses. Arresters exhibit an inductive character, with SFSD peak voltage at 10 kA approximately 4-5 times the 8 × 20 microsecond 10 kA discharge voltage. Polyethylene insulated cable has a characteristic degradation in which failure voltage decreases with number of SFSD pulses.

42830 Distribution transformer performance when subjected to steep front impulses. Burrage, L.M. (McGraw-Edison Power Systems Div., Franksville, WI (USA). Thomas A. Edison Technical Center); Shaw, J.H.; McConnell, B.W. *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA),* 5(2): 984-990 (Apr 1990). DOE Contract AC05-84OR21400.

The experimental method and the results of subjecting arrester protected pole type distribution transformers to the combined stresses caused by the conducted steep front impulse and rated 60 Hz voltages are described. Comparisons are drawn between these results and those of similar experiments on unenergized distribution transformers. It is concluded that tank mounted direct connected arresters provide a high degree of protection to these transformers, tank mounted externally gapped or crossarm mounted arresters may not provide sufficient protection; internal transformer insulation system failures caused by the steep front impulse do not necessarily result in immediate catastrophic failures of the transformers.

42831 Flashover vulnerability of transmission and distribution lines to high-altitude electromagnetic pulse. Kruse, V.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.); Tesche, F.M.; Liu, T.K.; Barnes, P.R. *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA),* 5(2): 1164-1169 (Apr 1990). DOE Contract AC05-84OR21400.

This paper estimates the vulnerability of transmission and distribution lines to flashover from the electromagnetic pulse generated by a nuclear detonation 400 kilometers above the earth. The analysis consists of first determining the cumulative probability of induced-voltage on three-phase lines, including shield and neutral conductors, for four operating voltages and then comparing these stresses to estimates of line insulation strength.

42832 Load flow studies in the presence of magnetohydrodynamic electromagnetic pulse. Kruse, V.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.); Rackliffe, G.B.; Barnes, P.R. *IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (USA),* 5(2): 1158-1163 (Apr 1990). DOE Contract AC05-84OR21400.

Seconds after a high-altitude nuclear event, the earth's surface experiences a very low-frequency, quasi-DC magnetohydrodynamic electromagnetic field (MHD-EMP). MHD-EMP fields impress quasi-DC currents on transmission and sub-transmission lines. These current magnitudes can exceed several times the transformer exciting current levels. Transformers and shunt reactors experience severe half-cycle saturation resulting in harmonics and increased VAR demand. This paper reviews the calculation of the quasi-dc currents, discusses the calculation of the increased var demand, and evaluates the effect of a simulated MHD-EMP event on a power system with stability and load flow analyses.

2407 Economic, Industrial, and Business Aspects

Refer also to citation(s) 42663

25 ENERGY STORAGE

2501 Magnetic

Refer also to citation(s) 43144, 43147

2506 Thermal

Refer also to citation(s) 42908

2509 Batteries

42833 (DOE/ID–10243-2-Vol.2-App.-Pt.2) **Assessment of battery technologies for electric vehicles: Volume 2, Appendices: Part 2.** Ratner, E.Z. (Sheladia Associates, Inc., Rockville, MD (USA)); Henriksen, G.L. (ed.). EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1990. 506p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (MISC–90024-Vol.2-App.-Pt.2). Order Number DE90014610. Source: NTIS, PC A22/MF A01 - OSTI; GPO Dep.

This document, Part 2 of Volume 2, provides appendices to this report and includes the following technologies, zinc/air battery; lithium/molybdenum disulfide battery; sodium/sulfur battery; nickel/cadmium battery; nickel/iron battery; iron/oxygen battery and iron/air battery. (FI)

42834 (EPRI-CU–6888) **Evaluation of electric vehicle battery systems through in-vehicle testing: Fifth annual report: Final report.** Keller, A.S. (Electrotek Concepts, Inc., Chattanooga, TN (USA)); Whitehead, G.D. Electric Power Research Inst., Palo Alto, CA (USA); Electrotek Concepts, Inc., Chattanooga, TN (USA). ©Jul 1990. 67p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This fifth annual summary report documents the tests performed from October 1988 through September 1989 in EPRI's ongoing project to evaluate and compare the performance of near-term electric vehicle traction battery packs in a real-world operating environment. The batteries are evaluated in electric vehicles to the end of life. Of major significance in this reporting period is the attainment of over 14,000 vehicle miles on each of two Chloride Electric Vehicle Systems (CEVS) 3ET205 lead-acid battery packs, and over 54,000 equivalent vehicle miles on the continued cycling of ten Eagle-Picher Industries (EPI) NIF270 nickel-iron modules. Also, an extensive analysis of range test data on vehicles equipped with Chloride EV5T lead-acid batteries is included. Testing includes initial acceptance testing of battery components and systems, daily in-vehicle operation of the batteries, monthly in-vehicle driving range tests, and periodic static (constant current) discharge tests under computer control. Battery performance data is typically presented on the basis of calculated specific energy output on a controlled discharge test versus accumulated vehicle/battery miles. Performance is also evaluated on the results of vehicle driving range tests over fixed operating cycles such as the SAE J227a "C" cycle or at 35 mph constant speed. A multiple linear regression analysis of the range test data on Chloride EV5T lead-acid battery packs in Griffon Vans indicates that on the average the "C" cycle range test has about 24 miles less range than the 35 mph constant speed range test. Also, this regression analysis shows that the achievable ranges are reduced about 2.7 miles for each 10°F reduction in ambient temperature and about 5.7 miles for each 10°F reduction in average battery temperature. 40 figs., 18 tabs.

42835 (N–90-21808) **Effect of LEO cycling on 125 Ah advanced design IPV nickel-hydrogen battery cells.** Smithrick, J.J.; Hall, S.W. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 8p. (NASA-TM–103128;E–5458;NAS–1.15:103128;CONF-900801–: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Source: NTIS, PC A02/MF A01.

An advanced 125 Ah individual pressure vessel (IPV) nickel-hydrogen cell was designed. The primary function of the advanced cell, is to store and deliver energy for long term, low earth-orbit (LEO) spacecraft missions. The new features of this design are: (1) use of 26 percent rather than 31 percent potassium hydroxide (KOH) electrolyte, (2) use of a patented catalyzed wall wick, (3) use of serrated edge separators to facilitate gaseous oxygen and hydrogen flow within the cell, while still maintaining physical contact with the wall wick for electrolyte management, and (4) use of a floating rather than a fixed stack (state-of-the-art) to accommodate nickel electrode expansion. Six 125 Ah flight cells based on this design were fabricated by Eagle-Picher. Three of the cells contain all of the advanced features (test cells) and three are the same as the test cells except they don't have catalyst on the wall wick (control cells). All six cells are in the process of being evaluated in a LEO cycle life test. The cells have accumulated about 4700 LEO cycles (60 percent DOD 10 C). There have been no cell failures, the catalyzed wall wick cells however, are performing better.

42836 (N–90-21844) **Electrochemical impregnation and cycle life of lightweight nickel electrodes for nickel-hydrogen cells.** Britton, D.L. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 6p. (NASA-TM–103140;E–5492;NAS–1.15:103140;CONF-9006146–: 34. international power sources symposium, Cherry Hill, NJ (USA), 25-28 Jun 1990). Source: NTIS, PC A02/MF A01.

Development of a high specific energy nickel electrode is the main goal of the lightweight nickel electrode program at NASA-Lewis. The approach was to improve the nickel electrode by continuing combined in-house and contract efforts to develop a more efficient and lighter weight electrode for the nickel-hydrogen cell. Lightweight plaques are used as conductive supports for the nickel hydroxide active material. These plaques are commercial products that are fabricated into nickel electrodes by electrochemically impregnating them with active material. The electrodes are life cycle tested in a low Earth orbit regime at 40 and 80 percent depths-of-discharge.

42837 (SAND–90-7016) **Zinc-bromine battery development, Sandia Contract 48-8838: Final report.** Richards, L. (Energy Research Corp., Danbury, CT (USA)); Vanschalwijk, W.; Albert, G.; Tarjanyi, M.; Leo, A.; Lott, S. Sandia National Labs., Albuquerque, NM (USA); Energy Research Corp., Danbury, CT (USA). May 1990. 101p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90014751. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes development activities on the zinc-bromine battery system conducted by Energy Research Corporation (ERC). The project was a cost-shared program supported by the US Department of Energy and managed through Sandia. The project began in September 1985 and ran through January 1990. The zinc-bromine battery has been identified as a promising alternative to conventional energy storage options for many applications. The low cost of the battery reactants and the potential for long life make the system an attractive candidate for bulk energy storage applications, such as utility load leveling. The battery stores energy by the electrolysis of an aqueous zinc bromide salt to zinc metal and dissolved bromine. Zinc is plated as a layer on the electrode surface while bromine is dissolved in the electrolyte and carried out of the stack. The bromine is then extracted from the electrolyte with an organic complexing agent in the positive electrolyte storage tank. On discharge the zinc and bromine are consumed, regenerating the zinc bromide salt. 5 refs., 44 figs.

42838 **Electrode kinetics of organodisulfide cathodes for storage batteries.** Liu, M. (Ceramatec, Inc., Salt Lake City, UT (USA)); Visco, S.J.; De Jonghe, L.C. *Journal of the Electrochemical Society (USA)*, 137(3): 750-758 (Mar 1990).

The electrode kinetics of a diverse group of organodisulfide cathode materials have been systematically investigated. The electrochemical behavior of these redox couples was studied as a function of the organic moiety (R) in the organodisulfide compounds (RSSR). These studies were performed with a variety of working electrodes, including platinum, glassy carbon, graphite, stainless steel, aluminum, and copper. The possible reaction pathways and mechanisms have been hypothetically postulated, theoretically analyzed, and experimentally verified. Observations showed that while electron transfer rate constants varied with organic moiety, the mechanistic details of the redox path were invariant with the R groups of the organodisulfides studies.

42839 **Mathematical modeling of the sodium/iron chloride battery.** Sudoh, M. (Lawrence Berkeley Lab., CA (USA). Materials and Chemical Sciences Div.); Newman, J. *Journal of the Electrochemical Society (USA)*, 137(3): 876-882 (Mar 1990).

A mathematical model of the sodium/iron chloride battery containing a molten $AlCl_3$-NaCl electrolyte is presented. A cylindrical cell consisting of a positive iron electrode, an electrolyte reservoir, a separator, and a negative sodium electrode is considered. The analysis uses concentrated-solution theory within the framework of a macroscopic porous electrode model. The effects of the state of discharge, the cell temperature, the precipitation and dissolution

rates of NaCl, and the current density on the current-potential relation during the discharge and charge cycles are discussed. The major influences on battery performances are changes in porosity and component volume fractions during cycling.

42840 Surface properties of PbO_2 and Bi-modified PbO_2 electrodes. Nielsen, B.S. (Ames Lab., IA (USA)); Davis, J.L.; Thiel, P.A. *Journal of the Electrochemical Society (USA),* 137(4): 1017-1022 (Apr 1990). DOE Contract W-7405-ENG-82.

The authors have studied the surface composition and vibrational properties of PbO_2 and Bi-doped PbO_2 electrode surfaces using Auger electron spectroscopy (AES) and high resolution electron energy loss spectroscopy (EELS). Deposition from perchlorate solution yields chlorine-rich oxides. For PbO_2, chlorine tends to segregate at the surface. For Bi-PbO_2 chlorine does not segregate at the surface, but the concentration of chlorine throughout the bulk of the oxide is about three times that in PbO_2. This suggests that Bi and Cl may be chemically bound in the doped oxides. Hydroxyl groups and hydrocarbon fragments are also present throughout the bulk of both films. Both oxides exhibit distinct phonon loss spectra, similar to those observed by other authors with EELS for many other oxides. Subtle differences between vibrational frequencies of the two oxides may be related to differences in surface crystallographic orientation or to differences in chemical composition.

42841 Ambient temperature high-rate lithium/organosulfur batteries. Visco, S.J. (Lawrence Berkeley Lab., CA (USA). Materials and Chemical Sciences Div.); Liu, M.; DeJonghe, L.C. *Journal of the Electrochemical Society (USA),* 137(4): 1191-1192 (Apr 1990). DOE Contract AC03-76SF00098.

This paper describes the study of ambient temperature lithium/organosulfer systems. Many organosulfur electrodes are inexpensive, biodegradable, relatively nontoxic, and fairly unreactive to molten sodium, implying safety risks may be minimal for these systems. Early tests showed that lithium metal was passivated by a number of electroactive organosulfur solutions; similar to the behavior of lithium metal in oxychloride catholytes. The results outline the behavior of one of many possible Li/RSSR cells, the lithium/(tetraethyl thiuram disulfide) battery.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis and Modeling

42842 (RISO-R–572) **Systems Analysis Department. Annual progress report 1989.** Larsen, H.; Mackenzie, G.A. (eds.). Risoe National Lab., Roskilde (Denmark). Systems Analysis. Mar 1990. 49p. Order Number DE90509414. Source: NTIS (US Sales Only), PC A03/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

The report describes the work of the Systems Analysis Department at Risoe National Laboratory during 1989. The activities may be classified as energy systems analysis, risk and reliability analysis and environmental modelling. The report includes a list of staff members. (author) 4. tabs., 21 ills.

2902 Economics and Sociology

Refer also to citation(s) 42847, 43573

42843 (IVL-B–982) **Thoughts about the concept - Sustainable Development.** Jerneloev, A. (Swedish Environmental Research Inst., Stockholm (Sweden)); Kristoffersson, L.; Larsson, L.G. Swedish Environmental Research Inst., Stockholm (Sweden). Mar 1990. 10p. (In Swedish). Order Number DE90512638. Source: NTIS (US Sales Only), PC A02/MF A01.

The concept 'Sustainable development' has gained political acceptance, but remains undefined and unprecise without any operational meaning. In this article we discuss whether S.D. should be used for technologies or projects, how an analysis of sustainablility could be made and the question of time horizons.

2903 Environment, Health, and Safety

Refer also to citation(s) 42849, 43249, 43256, 43257, 43271, 43276

42844 (IAEA-TECDOC–550, pp. 69-82) **Global and regional energy scenarios for the reduction of CO_2 emissions and the role of nuclear power.** Haefele, W. (Kernforschungsanlage Juelich GmbH (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The paper investigates the possibilities for a significant reduction of CO_2 emissions by 2030. The target figure for such a reduction is 4 GtC/year while the present energy related CO_2 emission is at 6 GtC/year. Such a target can only be met if all possibilities are being made use of, that is: a change of the fossil fuel use, the use of recycled biomass, of non carbon alternative energy sources, of nuclear power and the introduction of significant energy conservation. To that end existing energy scenarios are evaluated and a new scenario is introduced, the 1989 Juelich CO_2 reduction scenario for 2030. The Low Scenario of the International Institute for Applied Systems Analysis (IIASA) of 1975 serves as a reference case. Against that case the energy conservation scenarios of Colombo/Bernardini and of Goldemberg et. al. are compared. It turns out that only extreme measures can alleviate the situation of CO_2 emissions. Thus the paper essentially answers the question: "how impossible is impossible?" The difficulties become apparent when not only global figures but sub scenarios in seven different comprehensive world regions are being considered. It turns out that nuclear energy contributes in the 1989 Juelich scenario not only for electricity generation but also for high temperature nuclear process heat used for the reformation of natural gas. A total of 2 TWe of electricity generation capacity (partly meant as the equivalent of high temperature nuclear process heat) appears as necessary in the 1989 Juelich scenario. It nicely compares with the OECD/IAEA high estimate for 2025 which was 2.16 TWe. (author). 18 refs, 1 fig., 9 tabs.

42845 (ORNL–6608/R5) **Environmental regulatory update table, June 1990.** Houlberg, L.M.; Langston, M.E.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). Jul 1990. 104p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE90014760. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3447.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

42846 (PB–90-214388/XAB) **Resource Conservation Recovery Act notification data file (RCRA) documentation.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Mar 1990. 236p. Source: NTIS, PC A11/MF A02.

For system on magnetic tape, see PB–90-591300.

The document contains data compiled for the Resource Conservation Recovery Act. Notification of Hazardous Waste Activity, EPA Form 8700-12 was used to collect the data. The file was updated with information compiled from the application for a Hazardous Waste Permit, EPA Form 3510-3. The data includes names and addressed of the facility owner and operator, as well as the facility contact name and number. The data indicate whether a facility is a generator, treatment/storer/disposer, and/or transporter of hazardous waste. There is also a listing of code numbers of waste handled taken from 40CFR, Part 261.

2904 Energy Resources

Refer also to citation(s) 42619, 42862, 42892

42847 (ORNL/FTR–3660) **[Renewable energy project opportunities in the Philippines, Indonesia, and Thailand]: Foreign trip report, June 8–June 26, 1990.** Waddle, D.B. Oak Ridge National Lab., TN (USA). 6 Jul 1990. 22p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014314. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

I traveled to Jakarta, Manila, and Bangkok with a team of four other specialists to evaluate the potential for renewable energy project development in each respective country. The mission was sponsored by the Committee on Renewable Energy Commerce and Trade (CORECT) as the first step in a three-part process to increase trade opportunities between US equipment and services suppliers and potential markets in Southeast Asia. Several attractive opportunities were identified, that should be tracked closely by the industry groups and CORECT.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 42440, 42864, 42877, 43147, 43573

42848 (ORNL/CON–301) **The energy-related inventions program: Commercial progress of participants through 1988.** Brown, M.A. (Oak Ridge National Lab., TN (USA)); Wilson, C.R. Oak Ridge National Lab., TN (USA). May 1990. 63p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014771. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report provides information on the recent commercial progress of inventions supported by the Energy-Related Inventions Program (ERIP). It describes the results of the latest in a series of ERIP evaluation projects that have been completed since 1980. It focuses on the economic impacts of the program, notably sales and employment benefits. The period of interest is 1980 through 1988. The evaluation is based on data collected through telephone interviews describing 133 ERIP sponsored inventions. By the end of 1988, at least 88 ERIP inventions had entered the market, generating total cumulative sales of more than $400 million. With $21.4 million in grants awarded from 1975 through 1988, and $53.8 million in program appropriations over the same period, ERIP has generated a 19:1 return in terms of sales values to grants, and 7:1 return in sales versus program appropriations. It is estimated that 24% of all ERIP inventions had achieved sales by the end of 1988. While it is difficult to make exact comparisons between these percentages and other indicators of the success rates of technological innovations as a whole, the ERIP figures remain impressive. Employment benefits, tax revenues, sources of funding, and spin-off technologies are also discussed. Over time, second generation technologies and alternative applications of ERIP inventions have grown in importance as by-products of the program 21 refs., 11 figs., 2 tabs.

42849 (ORNL/FTR–3658) **[Meetings on the analysis and dissemination of demonstrated energy technology]: Foreign trip report, June 15, 1990–June 23, 1990.** Broders, M.A. Oak Ridge National Lab., TN (USA). 25 Jun 1990. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014016. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in the activities of the IEA-CADDET 8th Executive Committee Meeting. Highlights of this meeting included Japan's signing of the IEA-CADDET Implementing Agreement, status reports on analyses being performed by the CADDET Analysis Support Unit (CASU); and a general status report of CADDET activities including financial issues, extension of CADDET activities into demonstrated renewable energy technologies, and in-depth discussion of the CADDET strategy plan. The traveler also participated in the activities of the IEA-HPC Special Executive Committee Meeting, which include two days of intensive working-group sessions concerned with IEA-HPC strategic planning.

42850 (SERI/TP–260-3716) **Transferring building energy technologies by linking government and private-sector programs.** Farhar, B.C. Solar Energy Research Inst., Golden, CO (USA). Jul 1990. 63p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000346. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The US Department of Energy's Office of Building Technologies (OBT) may wish to use existing networks and infrastructures wherever possible to transfer energy-efficiency technologies for buildings. The advantages of relying on already existing networks are numerous. These networks have in place mechanisms for reaching audiences interested in energy-efficiency technologies in buildings. Because staffs in trade and professional organizations and in state and local programs have responsibilities for brokering information for their members or client organizations, they are open to opportunities to improve their performance in information transfer. OBT, as an entity with primarily R&D functions, is, by cooperating with other programs, spared the necessity of developing an extensive technology transfer program of its own, thus "reinventing the wheel." Instead, OBT can minimize its investment in technology transfer by relying extensively on programs and networks already in place. OBT can work carefully with staff in other organizations to support and facilitate their efforts at information transfer and getting energy-efficiency tools and technologies into actual use. Consequently, representatives of some 22 programs and organizations were contacted, and face-to-face conversations held, to explore what the potential might be for transferring technology by linking with OBT. The briefs included in this document were derived from the discussions, the newly published Directory of Energy Efficiency Information Services for the Residential and Commercial Sectors, and other sources provided by respondents. Each brief has been sent to persons contacted for their review and comment one or more times, and each has been revised to reflect the review comments.

42851 (TNDC–90014987) **List of scientific and technical literature relating to Thailand, No. 9.** Klomjai, S.; Prapasanobol, D. (comps.). Thailand Inst. of Scientific and Technological Research, Bangkok (Thailand). Thai National Documentation Centre. 1990. 235p. Order Number DE90014987. Source: NTIS (US Sales Only), PC A11/MF A01; OSTI; Thai National Documentation Centre, Bangkok, Thailand.

This document is supplementary to the previous issues of its series which, as usual, embraces books, periodical articles, papers from conference proceedings, theses and technical reports in science and technology providing information on Thailand and appeared in the country and abroad. The coverage of this series which intended to be as possible has been extended to include topics in socio-economic aspects of industry. Starting from a list of scientific and technical literature relating to Thailand, TNDC has established a database on the Hewlett Packard 300 computer system using the MINISIS software. However, its availability in publication form will also be disseminated as usual to various agencies.

42852 (TUD-MEMT–9) **Process and energy in the environment.** Bruinsma, O.S.L. (ed.). Technische Hogeschool Delft (Netherlands). Faculteit der Werktuigbouwkunde en Maritieme Techniek. Apr 1990. 102p. Order Number DE90509331. Source: NTIS (US Sales Only), PC A06/MF A01.

A general view is given of the work and the place of the Division Process and Energy of the Delft University of Technology within the world of research institutes, industry and society. Several papers were presented on the symposium. For three papers separate abstracts have been prepared. Short descriptions are presented of the laboratories for process equipment, thermal power engineering, refrigerating engineering and indoor climate technology as well as descriptions of research programs within the laboratories.

2906 Nuclear Energy

Refer also to citation(s) 42717, 42718, 42719, 42720, 42725, 42748, 42754, 42755, 42759, 42760, 42771, 42772, 42844, 42863

42853 (IAEA-TECDOC–550, pp. 117-128) **Safety objectives for an unsure public.** Rosen, M. (International Atomic Energy

Agency, Vienna (Austria). Div. of Nuclear Safety). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Despite an operating record marred by only one accident with consequences for public health, there remains widespread public concern that nuclear power and nuclear activities in general are too risky. This must be due in part to the nuclear community's collective inability to convincingly explain the realities of our radiation environment and the trivial changes introduced by nuclear power. Somehow an unsure public must regain confidence in nuclear power. The real challenge of the 1990s will be to gain broadscale acceptance of nuclear technologies as a safe, well-regulated and non-detrimental to human health and environmental well being. A proposal is made for accelerating the communication process about the realities of the radiation environment through a concerted international effort. Four complementary objectives are advanced that would provide an informed basis for individual and collective decision-making. (author).

42854 (IAEA-TECDOC–550, pp. 343-345) **Public acceptance of nuclear power.** Starr, C. (Electric Power Research Inst., Palo Alto, CA (USA)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some general aspects concerning the general question of what actions the technical community might take to keep nuclear power alive and growing are discussed.

42855 (KFK–4730) **Annual report 1989 of the Central Safety Department.** Koelzer, W.; Urban, M. (comps.). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Hauptabteilung Sicherheit. Apr 1990. 177p. (In German). Order Number DE90512940. Source: NTIS (US Sales Only), PC A09/MF A01.

The Central Safety Department is responsible for handling all problems of radiation protection, safety and security of the institutes and departments of the Karlsruhe Nuclear Research Center, for waste water activity measurements and environmental monitoring of the whole area of the Center, and for research and development work mainly focusing on nuclear safety and radiation protection measures. The research and development work concentrates on the following aspects: physical and chemical behavior of trace elements in the environment, behavior of tritium in the air/plant/soil system, biophysics of multicellular systems, improvement in radiation protection measurement and personnel dosimetry. This report gives details of the different duties, indicates the results of 1989 routine tasks and reports about results of investigations and developments of the working groups of the Department. The reader is referred to the English translation of the Table of Contents and of Chapter 1 describing the duties and organization of the Central Safety Department. (orig.).

42856 (ORNL/NSP–90/4) **Status of conversion of NE standards to national consensus standards.** Jennings, S.D. Oak Ridge National Lab., TN (USA). Jun 1990. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90014619. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

One major goal of the Nuclear Standards Program is to convert existing NE standards into national consensus standards (where possible). This means that an NE standard in the same subject area using the national consensus process. This report is a summary of the activities that have evolved to effect conversion of NE standards to national consensus standards, and the status of current conversion activities. In some cases, all requirements in an NE standard will not be incorporated into the published national consensus standard because these requirements may be considered too restrictive or too specific for broader application by the nuclear industry. If these requirements are considered necessary for nuclear reactor program applications, the program standard will be revised and issued as a supplement to the national consensus standard. The supplemental program standard will contain only those necessary requirements not reflected by the national consensus standard. Therefore, while complete conversion of program standards may not always be realized, the standards policy has been fully supported in attempting to make maximum use of the national consensus standard. 1 tab.

2908 Heat Utilization

Refer also to citation(s) 42658

2910 Conservation

Refer also to citation(s) 42843, 42849, 42877, 42878, 42894, 42895, 42909, 42917, 42918, 42919

42857 (DOE/MA–0416P) **Annual report on in-house energy management, FY 1989.** USDOE Office of Administration and Human Resource Management, Washington, DC (USA). Office of Project and Facilities Management. Jul 1990. 63p. Sponsored by U.S. DOE Management & Administration. Order Number DE90014737. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Each Federal Executive Agency is required by the Code of Federal Regulations to submit an "Annual Report on Energy Management." During FY 1989, the Department of Energy (DOE) completed its fourth year of operation under its Ten-Year In-house Energy Management Plan for FY 1986–FY 1995. This Annual Report will address program activities during FY 1989, summarize total program achievements, as well as evaluate progress toward the achievement of DOE efficiency and energy reduction goals as outlined in the Ten-Year Plan.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 42860, 42861

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 42428, 42431, 42432, 42434, 42856, 42860, 42861

2940 Fossil Fuels

Refer also to citation(s) 42345, 42347, 42369, 42373, 42863

2960 Electric Power

Refer also to citation(s) 42663, 42670, 42863, 42874, 42884, 43134

42858 (DOE/EIA–0191(89)) **Cost and quality of fuels for electric utility plants, 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 13 Jul 1990. 238p. Sponsored by U.S. DOE Management & Administration. Order Number DE90014382. Source: NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.

This document presents an annual summary of statistics at the national, census division, state, electric utility, and plant level regarding the quantity, quality, and cost of fossil fuels. The purpose of this publication is to provide energy decisionmakers with accurate and timely information that may be used in forming various perspectives on issues regarding electric power that may lie ahead. 4 refs., 55 tabs.

42859 (DOE/EIA–0226(90/04)) **Electric Power Monthly, April 1990.** USDOE Energy Information Administration, Washington, DC

(USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 12 Jul 1990. 169p. Sponsored by U.S. DOE Management & Administration. Order Number DE90014991. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Electric Power Monthly (EPM) presents monthly summaries of electric utility statistics at the national, Census division, and State level. The purpose of this publication is to provide energy decisionmakers with accurate and timely information that may be used in forming various perspectives on electric issues that lie ahead. 12 refs., 4 figs., 44 tabs.

42860 (NRRI–90-9) **Discussion papers on competitive bidding and transmission access and pricing issues in the context of integrated resource planning.** Burns, R.E.; Duann, D.; Rose, K.; Kelly, K.; Rau, N. National Regulatory Research Inst., Columbus, OH (USA). 19 Jan 1990. 61p. Sponsored by National Regulatory Research Institute. Source: OSTI; National Regulatory Research Institute, 1080 Carmack Road, Columbus, Ohio 43210.

The PUCO is considering opening investigation into what role competitive bidding, and power transmission access and pricing can play in Ohio's integrated power resource planning process. To assist the PUCO staff, the NRRI has identified critical issues about whether competitive bidding for power generation facilities and possibly demand side-management facilities is an effective means of integrated resource options, and how competitive bidding could affect Ohio's integrated power resource planning process. The NRRI has also identified key issues about how different state and federal policies on power transmission access and pricing might affect Ohio's integrated power resource planning. Discussion papers on each of the issues identified by the NRRI follow. The purpose of these discussion papers is to provide useful background information and to be used as an agenda for meetings on competitive bidding, and transmission access and pricing issues.

42861 (NRRI–90-10) **Electric transmission access and pricing policies: issues and a game-theoretic evaluation.** Kelly, K. (National Regulatory Research Inst., Columbus, OH (USA)); Eifert, M.; Hobbs, B.F. National Regulatory Research Inst., Columbus, OH (USA). May 1990. 290p. Sponsored by National Association of Regulatory Utility Commissioners; National Regulatory Research Institute. Source: OSTI; National Regulatory Research Institute, 1080 Carmack Rd., Columbus, OH 43210.

Competition in electric generation has brought increased attention to existing transmission access and pricing policies. New policies have been proposed by several parties (including NRRI). This study summarizes, the various proposals for reform, examines the issues they raise, and offers a way of analyzing the strategic behavior of sellers, wheelers, and buyers of wholesale power as they face new access and pricing rules. Finally, the study applies game theory as a way for regulators to evaluate behaviors and outcomes, both short run and long run. 60 refs., 54 figs., 13 tabs.

42862 (PNL–7420) **Preconstruction schedules, costs, and permit requirements for electric power generating resources in the Pacific Northwest.** Hendrickson, P.L.; Smith, S.A.; Thurman, A.G.; Watts, R.L.; Weakley, S.A. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 162p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC06-76RL01830. Order Number DE90013974. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report was prepared for the Generation Programs Branch, Office of Energy Resources, Bonneville Power Administration (BPA). The principal objective of the report is to assemble in one document preconstruction cost, schedule, and permit information for twelve specific generating resources. The report is one of many documents that provide background information for BPA's Resource Program, which is designed to identify the type and amount of new resources that BPA may have to add over the next twenty years to maintain an adequate and reliable electric power supply in the Pacific Northwest. A predecessor to this report is a 1982 report prepared by the Pacific Northwest Laboratory (PNL) for the Northwest Power Planning Council (the "Council"). The 1982 report had a similar, but not identical, content and format. 306 refs., 14 figs., 22 tabs.

2980 Consumption and Utilization

Refer also to citation(s) 42886, 42887

42863 (DOE/EIA–0035(90/04)) **Monthly energy review, April 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 25 Jul 1990. 135p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90014988. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

This document is the monthly report by the Energy Information Administration which presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. (FSD)

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 42892

42864 The commercialization process and future energy options. Brown, M.A. (Oak Ridge National Lab., Oak Ridge, TN (US)); Snell, S.A. pp. 2.225-2.234 of Proceedings of the international symposium on energy options for the year 2000: Volume 2. Heinonen, J.; Kainlauri, E.; Byrne, J.; Rich, D.; Salminen, M.; Seppanen, O. University of Delaware, Newark, DE (USA) (1988). (CONF-880920–: International symposium on energy options for the year 2000: contemporary concepts in technology and policy, Wilmington, DE (USA), 14-17 Sep 1988).

The commercialization of new energy technologies is a complex and difficult process. Few energy-related inventions are successfully translated into products and once on the market, many do not survive. Reasonable predictions about energy options in the year 2000 require a full understanding of the commercialization process as it pertains to new energy technologies. Drawing upon the experiences of the U.S. Department of Energy's Energy-Related Inventions Program (ERIP), this paper outlines some of the patterns, processes, and problems related to the commercialization of new energy technologies. Energy price fluctuations, inadequate investment capital, insufficient market demand, and inappropriate commercialization strategies are found to be common problems besetting ERIP inventors.

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

Refer also to citation(s) 42654

3005 Fuel Cells

Refer also to citation(s) 42838

42865 (DOE/ET/17089–2854) **Design, fabrication and testing of a solid oxide fuel cell stack for a 25 kW to 200 kW generator: Annual report, March 1986–March 1987.** Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center. May 1987. 60p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-80ET17089. Order Number DE90009665. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The objective of the High Temperature Solid Oxide Electrolyte Fuel Cell Power Generation System project is to perform research and development on fuel cells, modules and systems, which are requisite to the commercialization of the technology. Prior effort under the contract covered the period since June 1980 and culminated in placing on test a 5 kilowatt (kW) generator. Intermediate steps included testing of many materials and single cells (~15 watts), a three cell bundle (~45 watts) that was operated successfully for 9000 hours, and a 24 cell (~400 watts) submodule that was operated successfully for more than 2000 hours. The technical effort in the current modification is organized under three technical

tasks that have objectives as follows: To define a reference design, subsystem design, and component requirements for a tubular solid oxide fuel cell plant with the greatest potential to be commercialized; to develop and verify cell performance, which satisfies the component requirements; and to develop and verify stack performance, which satisfies the component requirements. In addition, post test analyses of the 5 kW generator have continued during this reporting period. A total of 360 cells were operated in the two tests of the 5 kW generator. 19 figs., 10 tabs.

42866 (ECN-C–90-013) **Membrane-based thin layer SOFC-technology: Second progress report July-December 1989.** Huijsmans, J.P.P.; Van der Molen, S.B. Netherlands Energy Research Foundation, Petten (Netherlands). May 1990. 16p. Contract CEC EN3E-0173-NL. Order Number DE90509337. Source: NTIS (US Sales Only), PC A03/MF A01.

The cooperative research program of ECN and the University of Twente (UT) on the title subject includes the following activities: Task 1 (ECN): Development of a flat plate support/air-electrode composite; Task 2 (UT): Application of a membrane on the supported air-electrode as a basis for thin electrolyte structures; Task 3 (UT): Application of thin electrolyte structures by (E)CVD techniques; Task 4 (ECN and UT): Characterization of microstructures and electrochemical properties of components and composites; Task 5 (ECN and UT): Interaction between electrode material and thin electrolyte structures. Work in the period July-December 1989 is summarized. 4 figs., 5 refs.

42867 (N–90-22835) **Catalysts for ultrahigh current density oxygen cathodes for space fuel cell applications. Final report, 1 February 1989-31 January 1990.** Tryk, D.; Yeager, E.; Shingler, M.; Aldred, W.; Wang, C. Case Western Reserve Univ., Cleveland, OH (USA). Jun 1990. 30p. (NASA-CR–180650;NAS–1.26:180650). Source: NTIS, PC A03/MF A01.

The objective of this research was to identify promising electrocatalyst/support systems for the oxygen cathode in alkaline fuel cells operating at relatively high temperatures, O2 pressures and current densities. A number of materials were prepared, including Pb-Ru and Pb-Ir pyrochlores, RuO2 and Pt-doped RuO2, and lithiated NiO. Several of these were prepared using techniques that had not been previously used to prepare them. Particularly interesting is the use of the alkaline solution technique to prepare the Pt-doped Pb-Ru pyrochlore in high area form. Well-crystallized Pb(2)Ru(2)O(7-y) was used to fabricate high performance O2 cathodes with relatively good stability in room temperature KOH. This material was also found to be stable over a useful potential range at approximately 140 C in concentrated KOH. Other pyrochlores were found to be either unstable (amorphous samples) or the fabrication of the gas-fed electrodes could not be fully optimized during this project period. Future work may be directed at this problem. High area platinum supported on conductive metal oxide supports produced mixed results: small improvements in O2 reduction performance for Pb(2)Ru(2)O(7-y) but a large improvement for Li-doped NiO at room temperature. Nearly reversible behavior was observed for the O2/OH couple for Li-doped NiO at approximately 200 C.

42868 Combined coal gasifier and fuel cell system and method. Gmeindl, F.D.; Geisbrecht, R.A. To Dept. of Energy, Washington, DC (USA). USA Patent 4921765/A/. 1 May 1990. Filed date 26 Jun 1989. USA Patent Application 7-371,144. Int. Cl. H01M 8/06. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a coal gasification and fuel cell system. It comprises: in combination coal gasification means for endothermically reacting coal or coal char in the presence of a catalyst, an external source of heat and steam for producing a stream of gaseous products containing carbon dioxide and hydrogen at a temperature in the range of about 1150° to 1050° F., a molten carbonate fuel cell means having anode means and cathode means, conduit means connecting the gasification means to the fuel cell means. Gas separating means in the conduit means for separating the carbon dioxide from the hydrogen, the conduit means comprising a first conduit means coupling the gas separating means and the anode means for conveying hydrogen.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

Refer also to citation(s) 42918, 42919, 43645

42869 (BFR-R–8-1990) **How to create low energy consumption in old, electrically heated one-family houses.** Stadler, C.G.; Aakerblom, B. Statens Raad foer Byggnadsforskning, Stockholm (Sweden). 1990. 73p. (In Swedish). Project BFR-880099-0. Order Number DE90512619. Source: NTIS (US Sales Only), PC A04/MF A01.

Four old houses heated by electric radiators have been retrofitted to reduce their energy consumption and power rating. The houses were given extra insulation and triple glazing was installed. The electric radiators were exchanged for hot air heating. Ventilation air heat was recovered with heat exchangers in two houses and with heat pumps in the other two. The costs for retrofitting were analyzed and seem to be unrealistic from the viewpoint of private economy.

42870 (BFR-R–13-1990) **Refrigerant HFC 134a. Compressor testing and theoretical calculations.** Petersson, B. (Royal Inst. of Tech., Stockholm (SE). Dept. of Applied Thermodynamics and Refrigeration); Thorsell, H. Swedish Council for Building Research, Stockholm (Sweden). Oct 1989. 55p. (In Swedish). Project BFR-871162-6. Order Number DE90512633. Source: NTIS (US Sales Only), PC A04/MF A01.

Measurements on the refrigerant HFC 134a are reported. Efficiencies using an open piston compressor of swash plate type have been measured. The refrigerant CFC 12 was used as a control. The efficiency were calculated according to the method of Wilson and Basa. Diagrams for dimensioning refrigerating and heat pump plants were also produced. The results show that HFC 134a can not match CFC 12 thermodynamically; but if the global environmental effects also are considered, there is a major advantage for HFC 134a.

42871 (BFR-R–20-1990) **Heat storage in eskers: Evaluation of the Haelsinggaard school at Falun.** Gustafson, G. (Viak AB, Falun (SE)); Lorick, L.; Ryttar, P.A. Swedish Council for Building Research, Stockholm (Sweden). 1990. 84p. (In Swedish). Project BFR-890981-9. Order Number DE90512635. Source: NTIS (US Sales Only), PC A05/MF A01.

At the school building, there has been installed a heat pump system based on an aquifer in an esker. The aquifer is heated in the summer by induced infiltration from a nearby lake. The original fuel oil heating system of the school had an consumption of 320 m^3 oil/year. The new system, including the 450 kW heat pump, will reduce the oil consumption by 70%. The investment cost amounted to 0.6 M dollar. The system and the operating experiences from the first two years are described in the report.

42872 (BFR-R–21-1990) **Glazed yards: A parametric study - climate and energy.** Wall, M. (Lund Univ. (SE). Dept. of Building Science). Swedish Council for Building Research, Stockholm (Sweden). 1990. 121p. (In Swedish). Project BFR-830332-4. Order Number DE90512636. Source: NTIS (US Sales Only), PC A06/MF A01.

The report comprises both simple stationary calculations and complex calculations using the DEROB-LTH program to determine the climate in different theoretical models of glazed areas. Three types of glazed yards are treated. The effect of varying parameters are studied for each model and compared between the models. The parameters varied are: number of panes, area, thermal inertia, orientation and ventilation rates. One result is that the climate can vary substantially depending on the design.

42873 (CHRI-RVG–5860-1) **Leakage measurements and efficiency measurements of a heat exchanger on the basis of heat accumulation and a diverter valve.** Van Gerwen, R.J.F. Cauberg-Huygen Raadgevende Ingenieurs BV, Maastricht (Netherlands); Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). Apr 1990. 48p. (In Dutch).

(NOVEM–90-379). Order Number DE90509335. Source: NTIS (US Sales Only), PC A03/MF A01.

The title subject concerns a Kantherm TS 300 heat recovery unit which recovers heat from ventilation air by means of heat accumulation and a diverter valve. Leakages can start because of the turning over of the valve, the flow back of ventilation air, or because of the final position of the valve (stationary leakage). By means of tracer gases leakages were measured. Stationary leakage is not measurable (< 1%). The other leakages are 5% on average. The results of the calculations and the measurements show that the efficiency of the heat recovery system can be calculated on the basis of average temperatures and an average leakage percentage. After a correction of the leakage (by means of a worst-case approach) the efficiency appears to be 77%. 14 figs., 2 tabs., 2 apps.

42874 (DOE/BP–1311) **Heat pump buyer's guide.** Haskell, T. Oregon State Univ., Corvallis, OR (USA). Extension Energy Program. Mar 1990. 25p. Sponsored by U.S. DOE Bonneville Power Administration. DOE Contract FC79-82BP34624. Order Number DE90014148. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document was written to give the customers at Bonneville Power Administration sufficient information to make intelligent choices as to whether to purchase a heat pump and, if so, how to make the correct choices. 8 figs. (FSD)

42875 (DOE/BP/35738–1) **Manufactured homes cost data analysis report.** Baylon, D. (Ecotope, Inc., Seattle, WA (USA)); Davis, B.; Lubliner, M. Ecotope, Inc., Seattle, WA (USA); Washington State Energy Office, Olympia, WA (USA). 8 Mar 1990. 25p. Sponsored by U.S. DOE Bonneville Power Administration. DOE Contract AM79-87BP35738. Order Number DE90014140. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report focuses on the reported costs for energy conservation measures installed in 150 manufactured homes by 8 manufacturers under the Residential Construction Demonstration Project (RCDP) sponsored by the Bonneville Power Administration. All measures were to meet the Super Good Cents (SGC) specifications for thermal performance and ventilation. The purpose of this report is to develop statistically standardized costs which reflect the incremental price paid by consumers for these energy conservation measures. Future reports will focus on the performance and cost effectiveness of these measures. The main source of information for this analysis was the cost database assembled by Pacific Northwest Laboratory (PNL) using information on wholesale prices collected from manufacturers. This was supplemented with information on actual materials costs obtained from suppliers. PNL also asked the manufacturers to provide confidential explanations of their pricing policies and the Washington State Energy Office administered a questionnaire for dealers asking about the set-up costs and final prices of the homes. These data were also used. 3 refs., 18 tabs.

42876 (DOE/CE/15407–T5) **Extended range tankless water heater: Quarterly report No. 5, April 20, 1990–July 19, 1990.** Harris, J.A. Harmony Thermal Co., Wichita, KS (USA). 27 Jul 1990. 3p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE15407. Order Number DE90014474. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This is the fifth quarterly report for DOE/ERIP Project No. FG01-89CE15407, Extended Range Tankless Water Heater. The objective of this project is to develop an innovative gas-fired tankless water heater certified by AGA and ready for commercial sale. Effort in the past three months has been directed primarily at development of a burner that will meet our design criteria. Progress in this area has been made, and we now feel confident that our objectives can be met. In addition to burner work, the other components in the gas train and ignition system have been procured, installed, and successfully tested on prototype units.

42877 (DOE/CE/22122–T1) **Fenestration research grant: Final report.** McCluney, R. Florida Solar Energy Center, Cape Canaveral, FL (USA). 20 Jul 1990. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-84CE22122. (FSEC-CR–345-90). Order Number DE90014937. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fenestration systems have numerous impacts upon the performances of buildings, including view, illumination, thermal gains and losses, and energy performance. These impacts can be positive or negative. Excellent energy savings and occupant satisfaction and productivity, and poor energy performance can result from bad design. The definition of proper fenestration design is not an easy one, since there are so many variables involved and because of the growing variability of fenestration products available. The vendors of these products make performance claims aimed at a variety of performance goals, but the list of issues addressed is seldom complete and comprehensive. Better characterization of the instantaneous energy and other performances of fenestration products is an important first step in increasing the designer's ability to create viable, cost-effective, and energy efficient designs. Next would be improved methods for calculating long-term performances. Finally we need better design tools that will incorporate new knowledge about fenestration performances in ways that enable designers rather than disable them. This report covers work done from the beginning of work on this grant late in 1984 to its end on 30 March 1990. 22 refs., 5 figs.

42878 (DOE/SF/17960–T3) **The energy efficient industrialized housing research program: Quarterly technical progress report, April 1–June 30, 1990.** Brown, G.Z. Oregon Univ., Eugene, OR (USA). Center for Housing Innovation. [1990]. 10p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC03-89SF17960. Order Number DE90014614. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The United states housing industry is undergoing a metamorphosis from hand built to factory built products. Virtually all new housing incorporates manufactured components; indeed, an increasing percentage is totally assembled in a factory. The factory-built process offers the promise of houses that are more energy efficient, of higher quality, and less costly. To ensure that this promise can be met, the US industry must begin to develop and use new technologies, new design strategies, and new industrial processes. However, the current fragmentation of the industry makes research by individual companies prohibitively expensive, and retards innovation. This research program addresses the need to increase the energy efficiency of industrialized housing. Two research centers have responsibility for the program: the Center for Housing Innovation at the University of Oregon and the Florida Solar Energy Center, a research institute of the University of Central Florida. The two organizations provide complementary architectural, systems engineering, and industrial engineering capabilities. In 1989 we worked on these tasks: the formation of a steering committee; the development of a multiyear research plan; analysis of the US industrialized housing industry; assessment of foreign technology; assessment of industrial applications; analysis of computerized design and evaluation tools; and assessment of energy performance of baseline and advanced industrialized housing concepts. Our goal is to develop techniques to produce marketable industrialized housing that is 25% more energy efficient that the most stringent US residential codes now require, and that costs less. Energy efficiency is the focus of the research, but it is viewed in the context of production and design. 63 refs.

42879 (IBP-WB–45/1989) **Effects of window design on heat losses through walls.** Szerman, M.; Erhorn, H.; Gertis, K.A. Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.). [1989]. 29p. (In German). Contract BMFT 03E-8506-A/B. Order Number DE90510164. Source: NTIS (US Sales Only), PC A03/MF A01.

The insulation properties of window systems with temporary or permanent thermal insulation can be considerably reduced when mistakes are made in the design and construction phase. The impact of different positions of the window on its thermal transmission loss has been investigated on four commonly used types of masonry systems having the same k-value. For the different types the following locations have been revealed to be the best: 1. for monolithic external walls the window should be in the middle of the building unit with rebate; 2. for external walls with external insulation the window should be on the outside of the building unit with rebate; 3. for external walls with core insulation the window should be in the middle of the building unit with rebate; 4. for external

walls with internal insulation the window should be on the inside of the building unit with rebate. For these four types of construction the additional heat loss which has to be taken into account in future calculations is nearly the same. Masonry rebates considerably reduce the additional heat losses. For window constructions on the outside of the building unit, which are favourable for externally insulated walls, it has to be taken into account that the weathertightness is not as good. (BR).

42880 (IfB-F–702) **Effects of air pollution on buildings.** Brocher, E.; Zapke, W.; Friedrich, H.; Ebert, H. Institut fuer Bauforschung e.V., Hannover (Germany, F.R.); Sozialministerium des Landes Niedersachsen, Hannover (Germany, F.R.). Dec 1988. 62p. (In German). Source: Copy held by UB/TIB Hannover.

In this report the assumption is confirmed, that air pollution damages all the buildings. Primarily an examination of external walls, windows and roofs was carried out. At these building elements cracks, discolouration, flaking and damage can be seen easily. The polluted air is mostly brought to the buildings by rain, hail and snow. Dry and humid atmospheric pollutants best stick to uneven porous surfaces. Smooth closed surfaces provide almost no target. Therefore already in the first stage of the project building materials have to be chosen and used which due to their surface structure counteract possible influences of atmospheric pollutants. (EF).

42881 (LIU-TEK-LIC–1990-22) **The ELVA-model: Alternatives to electric heating.** Linkoeping studies in science and technology. Thesis. Lewald, A. Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering. 1990. 130p. (In Swedish). Order Number DE90512615. Source: NTIS (US Sales Only), PC A07/MF A01.

The ELVA-model has been elaborated in order to evaluate and compare possible measures to change the energy system in detached houses, heated with electric resistance heaters. In connection with an expected rise of electricity prices the interest is considerable for alternative heating systmes in these houses. The houses in the model is looked upon as an energy system; the model is optimizing and the aim of the optimization is lowest possible life-cycle cost. The mathematical optimization method used is mixed integer programming. The way to work with the ELVA-model is to map the measures of interest to analyse, both in economical and technical sense, then describe how the different measures are possible to connect to the energy system of the house. All the mapping is then put into an optimization program in which the combination of measures that minimizes the life-cycle cost is found. The thesis is mainly a mathematical description of the model, but also a description of how different measures can be mapped. The model is not limited only to study these houses, but could be used for the study of any house. The conclusions of greatest interest in the thesis are, with reservations made in the text that: * the economic space today is small to lower the life-cycle cost of these houses considerably, through changing the energy system in any way; * even in future, electricity is able to compete with fuels to heat these houses; * if a time-of-use rate is introduced attention is drawn to the relatively cheap measures with control the water heating to be made at low price and which lower the power consumption during a period of time with high prices; * extra insulation of external walls is of interest not of energy economic reasons only, in houses heated with electric resistance heaters. (80 refs.).

42882 (ORNL/FTR–3651) **[Meetings on air flow patterns within buildings]: Foreign trip report, May 31, 1990–June 16, 1990.** Harrje, D.T. Oak Ridge National Lab., TN (USA). 20 Jun 1990. 10p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90013391. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the field of building air flow simulation and measurement, new developments are occurring at a rapid rate. The visit by the traveler to Bruel & Kjaer, Denmark, points out one advanced technology tracer gas measurement system that is beginning to be used worldwide. The Annex 20 activities highlights the steadily increasing number of international experts that are focusing on the numerical simulation, measurement and data recording challenges associated with air flow patterns within buildings. The two subtasks in the Annex are making steady progress toward their goals in quantifying single room and multi-room related air flow. Handbooks, technical papers and data formats are close to being released on many of the topic areas. The international conference Roomvent '90 further points to the widespread interest in these subject areas, what progress has been made and what lies ahead.

42883 (ORNL/FTR–3652) **[Meetings on low slope roof systems in Denmark]: Foreign trip report, June 14, 1990–June 19, 1990.** Courville, G.E. Oak Ridge National Lab., TN (USA). 25 Jun 1990. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90013398. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler represented the United states and participated as the Operating Agent at the working session of Annex 19 in Low Slope Roof Systems. The Annex revised the final draft of the Annex report on good practices for design, installation and maintenance of low slope roofs. Assignments were made to improve the document and prepare the second draft. Prof. V. Korsgaard presented a tour of laboratory facilities of the Danish Technical Institute. The focus of work is in solar devices and a potential vapor retardant material. The work of Annex 19 was summarized and critiqued along with that of 3 other annexes by members of the IEA/BCS Executive Committee.

42884 (PNL–7385) **End-use load and consumer assessment program: Heat loss characteristics of the residential sample.** Connor, C.C.; Lortz, V.B.; Pratt, R.G. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 92p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE90014298. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The End-Use Load and Consumer Assessment Program (ELCAP) conducted for the Bonneville Power Administration by Pacific Northwest Laboratory was initiated to support both conservation assessment and load forecasting missions. This report documents a study of the heat loss characteristics of the ELCAP residential buildings. The basic objectives of this analysis are to: calculate theoretical residential heat loss rate based on the onsite inspection data for use in support of subsequent analyses, determine the distribution of insulation levels and heat loss potential as a function of construction vintage and climate zone, support use of the ELCAP Residential Standards Demonstration Program (RSDP) houses for analysis of the impact of Model Conservation Standards (MCS) by determining the degree to which their construction conforms to the design specifications, and test the specification of current code used in the RSDP experiment. The analysis of the heat loss characteristics of the ELCAP Residential sample leads to several conclusions based on the building-level structural characteristics. These include: the distribution of overall residential heat loss potentials with construction vintage indicates a strong tendency toward lower heat loss potential in newer houses; there is a clear trend toward increasing occupied floor space in newer houses; the data show a steady increase in overall insulation levels in more recently constructed houses; heated basements tend to be concentrated in the two colder climate zones, there is a steady decline in occurrence of crawlspaces and increase in occurrence of heated basements with severity of climate; the distribution of foundation types in the sample does not strongly influence the general trend to higher insulation levels in newer houses and houses in colder climates. 21 refs., 36 figs., 28 tabs.

42885 (SBI-ANV–162) **Investigation of energy consumption in heating and ventilation systems.** Aggerholm, S.; Dinesen, J. Statens Byggeforskningsinstitut, Hoersholm (Denmark). 1990. 40p. (In Danish). Source: Available from Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm, Denmark. DKK.80.

EFP-85.

A factor of significance in relation to energy conservation is the carrying out of investigations with the aim of localizing excess consumption. Such investigations, and methods for measuring operation parameters and energy efficiency in relation to parts and components of heating and ventilation systems, are systematically described. The guidelines are relevant to enginering firms, producers, suppliers and consultants etc. (AB) 15 refs.

42886 (TNO-HMT–90-044) **Recommendations with regard to the regulation of the energy consumption of domestic refrigerating equipment.** Vermeulen, P.E.J. Hoofdgroep

Maatschappelijke Technologie TNO, Apeldoorn (Netherlands); Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). Mar 1990. 95p. (In Dutch). (NOVEM–90-389). Order Number DE90509327. Source: NTIS (US Sales Only), PC A05/MF A01.

A study on possible legislative measures to control the energy consumption of domestic refrigerators and freezers was carried out by the Department of Heat and Refrigeration Technology of the Netherlands Organization for Applied Scientific Research (TNO). Possible legislative measures are: mandatory energy labelling (energy consumption, category, performance), and mandatory energy efficiency standards (maximum energy consumption in correlation to the volume, determination of limiting values). As part of the title project the international state of affairs with regard to the legislative measures was reviewed. Also attention was paid to the market for domestic refrigerating equipment in the Netherlands. Both subjects are dealt with in separate reports. The results of both studies are used to work out recommendations for the conception, introduction and execution of mandatory energy labelling and mandatory energy efficiency standards. 19 figs., 25 refs., 11 tabs., 1 app.

42887 (TNO-HMT–90-045) **The characterization of the market supply and the energy consumption of domestic refrigerating equipment.** Vermeulen, P.E.J. Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands); Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). Mar 1990. 92p. (In Dutch). (NOVEM–90-390). Order Number DE90509328. Source: NTIS (US Sales Only), PC A05/MF A01.

A study has been carried out to characterize the current domestic refrigerator market. The supply side of the market has been grouped in functional categories, subdivided in volume categories. For each category, the spreading of specific energy consumption has been analysed. It is found that significant differences occur in specific energy consumption within one category: the ratio of highest and lowest consumption ranges from 1.5 to 4.5 with an average of over 2. On the average, appliances with a low energy consumption are more expensive than similar appliances with a high energy consumption. For a given value of the energy consumption there is however a large scatter in price. Because of this, one can almost always buy an appliance with a relatively low energy consumption against a relatively low price. An estimate has been made of the distribution of sales as a function of the specific energy consumption. For almost 200,000 appliances, sold in 1988, it is found that 39% is energy efficienct, 41% has an average energy consumption, and 20% uses more than average energy. This distribution correlates rather well with the distribution of the number of different models. 30 figs., 14 refs., 11 tabs., 2 apps.

42888 (TNO-TPD–814.017) **Translucent thermal insulation in facades: An investigation.** Van Dijk, H.A.L.; Van Paassen, J.P.; Van der Stel, R.; Arkesteijn, C.A.M. Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst; Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). Feb 1990. 84p. (In Dutch). Contract NOVEM 881700/8815;Contract NOVEM 61630.0110. (TNO-TPD–914.070;NOVEM–90-318). Order Number DE90509336. Source: NTIS (US Sales Only), PC A05/MF A01.

An overview is given of the measured and deducted thermal-optical properties of translucent insulation materials (TIM). It appears that materials with a honeycomb structure and silica aerogel types are promising even compared to modern extra insulated double glass. By means of dynamic calculations at a reference translucent insulated (TI) facade the energetic potential has been estimated. Also the impact of the temperature dependence and the angle dependence of the TIM-properties on the energetic potential was calculated. Possible energy savings by application of TI-facades in dwellings are indicated. Present and future designs of TI-facades are presented. An overview is given of a number of the latest demonstration projects. Measurements were carried out on a prototype TI-facade in a test facility for facade systems. It is concluded that for large-scale application the time is not ripe yet. Recommendations are given with regard to short-term applications, medium-term and long-term insulation material developments and system developments. 36 figs., 39 refs., 18 tabs., 4 ills.

42889 (TUD-MEMT–9, pp. 6.1-6.12, Paper 6) **Absorption systems: Large CFC reduction and large energy saving potential for cooling and heating.** Machielsen, C.H.M. (Delft Univ. of Technology (Netherlands). Lab. for Refrigerating Engineering and Indoor Climate Technology). Technische Hogeschool Delft (Netherlands). Faculteit der Werktuigbouwkunde en Maritieme Techniek. Apr 1990. In *Process and energy in the environment.* Order Number DE90509331. Source: NTIS (US Sales Only), PC A06/MF A01.

Due to the CFC-issue, the refrigeration industries are confronted with limitations of the use of CFC 11, 12, 114 and 502 and probably long term restrictions of HCFC 22. Alternative refrigerating systems without CFC's may contribute to the solution of this problem. The use of future, ozone friendly, refrigerants in conventional compression systems leads to increase of energy consumption. So this is not a good alternative, because of another environmental aspect: the greenhouse effect. It is expected that as CFC-free heat pumps absorption heat pumps will continue to gain in importance for cooling and heating purposes. An overview is given of the research activities on absorption systems in the Laboratory for Refrigerating Engineering and Indoor Climate Technology at the Delft University of Technology in the Netherlands. The research projects are: an absorption heat pump for domestic heating, fundamental research on heat and mass transfer in absorbers, a solar-driven absorption refrigeration machine, an absorption heat transformer for upgrading industrial waste heat, and a hybrid heat pump system. For each of these projects a test plant is built and the experimental results are used to validate the simulation programs in order to carry out the optimization work. 6 figs., 6 refs.

42890 (TUD-MEMT–9, pp. 7.1-7.14, Paper 7) **Environmental aspects of the indoor climate.** Van der Kooi, J. (Delft Univ. of Technology (Netherlands). Lab. for Refrigerating Engineering and Indoor Climate Technology); Qingyan, C.; Van Paassen, A.H.C. Technische Hogeschool Delft (Netherlands). Faculteit der Werktuigbouwkunde en Maritieme Techniek. Apr 1990. In *Process and technology in the environment.* Order Number DE90509331. Source: NTIS (US Sales Only), PC A06/MF A01.

The indoor air quality in residences and commercial buildings is an important environmental problem during the last years. The amount of complaints has been increased strongly. Research problems related to this problem are: sick building syndrome, passive building control with natural ventilation, and efficient ventilating systems. All subjects are discussed briefly. 5 figs., 13 refs., 1 ref.

42891 Proceedings of the international symposium on energy options for the year 2000: Volume 3. Energy and buildings. Heinonen, J.; Kainlauri, E.; Byrne, J.; Rich, D.; Salminen, M.; Seppanen, O. 3.21p. University of Delaware, Newark, DE (USA) (1988). (CONF-880920–: International symposium on energy options for the year 2000: contemporary concepts in technology and policy, Wilmington, DE (USA), 14-17 Sep 1988).

This book contains the proceedings of the international symposium, energy options for the year 2000, volume 3 energy and buildings. Topics covered include: Indoor air quality, Intelligent buildings, Solar and conservation options for buildings, Energy and engineering, and Energy and architecture.

42892 Proceedings of the international symposium on energy options for the year 2000: Volume 2. Technology futures. Heinonen, J.; Kainlauri, E.; Byrne, J.; Rich, D.; Salminen, M.; Seppanen, O. 2.2888p. University of Delaware, Newark, DE (USA) (1988). (CONF-880920–: International symposium on energy options for the year 2000: contemporary concepts in technology and policy, Wilmington, DE (USA), 14-17 Sep 1988).

This book contains the proceedings of the International Symposium on energy options for the year 2000, volume 2, technology futures Topics covered include: energy efficiency, biomass and peat as alternative fuels, solar and conservation technologies, environmental aspects of combustion, and technology futures.

42893 Tracing the sources of indoor aerosols using combustion-evolved gas analysis. Daisey, J.M. (Lawrence Berkeley Lab., CA (USA)); Gundel, L.A. pp. 147-148 of Proceedings of the Air and Waste Management Assoc. 82nd annual meeting and exhibition (Abstracts). Air and Waste Management Assoc., Pittsburgh, PA (USA) (1989). (CONF-890692–: 82. Air and

Waste Management Association annual meeting and exhibition, Anaheim, CA (USA), 25-30 Jun 1989).

Technical Report 89-145.3.

This paper presents an exploratory study conducted to determine if micro-analytical combustion-evolved gas analysis (CEGA) for measuring organic and inorganic carbon and nitrogen could be used to distinguish aerosols from different indoor sources. The method requires less than 20 μg of particulate matter and it is rapid and inexpensive. Thermograms (rate of evolution of CO_2 and NO_x versus temperature) were determined for samples of environmental tobacco smoke (ETS), kerosene soot, indoor aerosol from woodburning homes and outdoor aerosol from New Jersey. The thermograms were used to calculate the amounts of carbon and nitrogen for five temperature intervals from 50 to 600°C, normalized to particle mass.

42894 Retrofit experience in US multi-family buildings. Greely, K. (Lawrence Berkeley Lab., CA (USA)); Goldman, C. *Home Energy (USA)*, 6(2): 16-20 (Mar-Apr 1989).

The authors collected information on retrofit projects from multifamily buildings through their Building Energy use Compilation and Analysis project, and their results are presented. Retrofits in privately owned fuel-heated buildings are typically low-cost and have short paybacks, especially when they focus on heating and hot-water-system improvements. At public housing projects, over twice as much is spent to achieve the same level of savings, because housing authorities install more expensive retrofits with the dual purpose of saving energy and improving building appearance while reducing maintenance costs. In electrically heated buildings, payback times for the commonly installed window and insulation retrofits were often longer than 20 years. Based on current program experience in electrically heated buildings, results suggest that it is not cost-effective to spend more than $2,000/apartment. Economics could be improved by limiting costs, targeting high users, and emphasizing less-expensive retrofits, including lighting and hot-water measures.

42895 Home energy rating systems: Information to increase efficiency. Hendrickson, P. (Pacific Northwest Laboratories, Hanford, WA (USA)). *Home Energy (USA)*, 5(5): 22-26 (Nov-Dec 1988).

House hunters may find valuable information through a home energy rating system (HERS). HERS usually certify that a home meets a specific level of energy efficiency or that is contains specific energy features. Some HERS, probably the most useful, rate a home according to a scale, telling the consumer not only that a home is good enough, but just how good it is. Many HERS programs are limited to new single-family homes. Others include existing single-family homes and apartment units. Manufactured homes are less commonly included. Housing consumers can get energy-efficiency information from several other sources: the building energy code to which the home was built, audits, and home inspections. However, as yet none of these is widely used as a criterion for choosing a home, possibly because their effective use requires some basic energy-efficiency knowledge and some decisive action on the part of the housing consumer. HERS ratings are understandable by someone with little knowledge of home energy efficiency and are increasing being used as a selling point in the housing market. 11 refs., 1 fig., 4 tabs.

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Refer also to citation(s) 42934

42896 (CONF-8710452–, pp. 5-18) **Two dimensional detonation effects on laser propulsion thruster performance.** Chang, I.D. (Stanford Univ., CA (USA)); Mulroy, J.R. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

Two dimensional effects on laser propulsion performance were studied analytically using an ideal gas model. The two processes considered for an axially symmetric detonation wave are the effect of radial expansion within the detonation reaction layer and the effect of radial expansion in the region between the detonation wave and the base plate. In both cases, the two dimensional effects cause the reduction of the base pressure and the total thrust. The amount of reductions of base pressures are calculated and are plotted as functions of the reaction length/beam radius and beam radius/detonation wave travel distance, respectively. 13 refs., 5 figs.

42897 (CONF-8710452–, pp. 19-42) **Aspects of acoustic noise generation by a laser-propelled vehicle.** Chang, I.D. (Stanford Univ., CA (USA)); Ishikawa, M.Y. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

The modeling of acoustic noise generation by a laser-propelled ground-to-space launch system has not previously been examined to our knowledge. The development of large lasers funded under the auspices of the Strategic Defense Initiative, resurrected serious interest both in laser-propelled vehicles and their ramifications to the cost-effective transportation into space of significant quantities of mass. Many aspects of the aero-acoustic physics associated with a ground-to-space laser-propulsion launch system are believed to be unique. In this paper, the generation of aoustic noise by a laser-propelled vehicle is examined. The analytical models presented here allow a reasonable estimate to be made of the levels of characteristic aero-acoustic noise generated by periodically and explosively driven, accelerating vehicles. 19 refs., 17 figs., 3 tabs.

42898 (CONF-8710452–, pp. 43-56) **Computational studies of laser supported detonations.** Emergy, M.H. (Naval Research Lab., Washington, DC (USA)); Kailasanath, K.; Oran, E.S.; Gardner, J.H. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

This paper describes the objectives, approach, and preliminary results of our efforts to simulate numerically the physics occurring in a laser-supported detonation (LSD). The objective is to use the simulations to help determine whether it is possible to design a laser propulsion system for ground-to-orbit propulsion that consists of nothing but a payload and a clean propellant. In order to maximize both thrust and energy efficiency, a two step process is envisioned. In the first step, a very low intensity, long duration, O(μs), laser prepulse is used to ablate enough gas from the surface of the solid/liquid propellant to form a buffer gas layer. A second, high intensity, short duration laser pulse irradiates the gas layer, depositing its energy in the gas layer just before reaching the propellant surface. A shock wave then propogates out through the gas layer, back towards the laser, heating and accelerating it. What is effectively a detonation (LSD) is formed by the shock wave followed by the recombination zone behind it. The approach has several stages. The authors had previously constructed several numerical models that they used to simulate ignition and propagation of chemical donations and to study laser-matter interactions. The first stage of the current work is to modify these models so that they supported detonation (LSD) and to perform preliminary tests and calculations to make sure that the models are in fact producing realistic results. The second stage is to use the models to explore the parameter range for the double-pulse experiments currently planned. In this paper they show results of the first stage, and discuss the plans for the second stage. 15 refs., 4 figs., 1 tab.

42899 (CONF-8710452–, pp. 57-102) **Issues in laser propulsion.** Rollins, C.; Bailey, A.; Gelb, A.; Rosen, D.; Weyl, G.; Wu, P. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

A broad range of issues of importance in the application of the double pulse LSD thruster is explored theoretically, experimentally,

and via computer simulation. Issues addressed include propellant selection criteria, prompt ignition of plasma, advantages of the pulse pair approach, and effects of molecular recombination in the expanding plume. 17 refs., 23 figs., 3 tabs.

42900 (CONF-8710452–, pp. 103-110) **Double-pulse laser propulsion of polyethylene.** Hale, M.O. (Spectra Technology Inc., Bellevue, WA (USA)); Boss, D.; Vlases, W.; Black, J. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

An experimental apparatus is described for measuring ablated mass loss, coupling coefficients, specific impulse and efficiencies of double-pulsed laser propelled projectiles. An initial CO_2 laser ablates surface material with a power density of 2.0×10^7 W/cm^2. A second more powerful CO_2 laser is delayed from the first by a variable time ranging from 0 to 1000 ns. This second laser has a power density of 3.0×10^8 W/cm^2 and primarily heats the ablated vapors to a high temperature. The optimum conditions are measured to be at laser delay time to 100 ns where the specific impulse is 908 sec, the coupling coefficient is 1.38 dyne-s/J and the thruster efficiency is 7.50%. The trends in the data as a function of laser delay time is in agreement with a simple LSD heating picture. Future directions and improvements for this experiment are also indicated. 5 figs.

42901 (CONF-8710452–, pp. 111-144) **Laser propulsion studies.** Reilly, D.A. (Avco Research/Textron, Everett, MA (USA)). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

This paper covers the following studies: (1) the importance of ignition, shielding issue to rocket performance; (2) design of short pulse experiments; and (3) design of long pulse experiments. The design of short pulse experiments includes energy scaling, laser issues, target handling, and diagnostics. The long pulse experiments include energy scaling and laser issues. 29 figs.

42902 (CONF-8710452–, pp. 145-156) **Advanced propellant for laser propulsion.** Reilly, D.A. (Avco Research/Textron, Everett, MA (USA)). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

The double-pulse detonation-wave laser propulsion rocket receives its thrust from a succession of laser pulse pairs incident on a solid inert propellant. The propellant is vaporized from the solid surface by the first pulse in the closely spaced pulse pair. The second pulse of the pair ignites a laser-driven detonation wave off that same surface. This detonation wave then propagates through the predisposed propellant gas, heating it to a roughly uniform temperature. If this detonation wave is not ignited uniformly and on very shot time scale, enough propellant material will be vaporized by the thrust pulse to have a significant deleterious influence on the specific impulse and efficiency of the rocket. The author's proposed solution to the problem of obtaining fast, uniform ignition of the detonation waves is based on designing the propellant block so that there are always defects available on the surface of the rocket base. These defects are designed to act as dipoles tuned resonantly to the 10.6 micron radiation. They will be closely and uniformly spaced so that plasmas originating at each dipole will be able to quickly unite and to form a uniform absorption front. The terminology tuned ignition array (TIA) has been chosen to describe the design. 10 figs.

42903 (CONF-8710452–, pp. 157-164) **Orbital maneuvering via pulsed laser propulsion.** Chapman, P.K. (Space Energetics, Inc., Mountain View, CA (USA)); Reilly, D.A. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

The objective of this paper is to explore means of expanding the mission scenario for double-pulse laser propulsion to the area of orbital-plane changes and orbit raising, while still keeping the advantages of the double-pulse technique. The proposed method would involve carrying a reflective optical element along with the rocket. This element would serve both to redirect a laser beam coming from any of a large range of angles onto the base of the rocket. In the process, it would also concentrate the flux from the low value resulting from the long range between the laser and the rocket up to the high value of tens of megawatts per square centimeter necessary for the detonation-wave process to work. The reflector would have to be light in weight, which implies that it would have to be passively cooled. Its shape would have to be variable in order to achieve the desired concentration when flux is incident from the various angles. The author will show that a thin-film design could be compatible with these requirements. For the purpose of discussion, we will assume a system that makes use of a laser scaled for entry-level launching of 10-kg objects from ground into low orbit. Calculations presented elsewhere have shown that a 20-MW laser in conjunction with a 10-m mirror on the ground would be capable of launching such a payload. As will be seen, much larger payloads can be maneuvered in orbit using the system to be described. 7 figs.

42904 (CONF-8710452–, pp. 165-173) **Geometric constraints in laser-powered orbital maneuvers.** Chapman, P.K. (Space Energetics, Inc., Mountain View, CA (USA)); Reilly, D.A. Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

The objective of this note is a preliminary assessment of geometric and orbital constraints on operation of the laser propulsion system discussed in a companion paper (Orbital Maneuvering via Pulsed Laser Propulsion, by P.K. Chapman and D.A. Reilly). The proposed system uses relay mirrors in equatorial orbit to transfer power from a pulsed ground-based laser to the thruster aboard the maneuvering vehicle. While much more work is needed on the geometry and dynamics of orbital maneuvering with this system (including operations with vehicles in inclined and elliptic orbits), these preliminary results suggest that an entry level laser (about 20 MW) can provide a useful capability. Such a system should be able to effect major changes in the orbits of payloads of order one metric ton or more, during a single pass over the laser. Much larger payloads could be maneuvered by thrusting during a number of passes.

42905 (CONF-8710452–, pp. 173-208) **Airbreathing laser propulsion for transatmospheric vehicles.** Myrabo, L.N. (Rensselaer Polytechnic Institute, Troy, NY (USA)). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

This paper is divided into six parts. In the first part, the four candidate combined-cycle engine concepts are listed. They are as follows: (1) ERH thruster - ramjet - scramjet - rocket; (2) ERH thruster - ramjet - rocket; (3) ERH thruster - scramjet - rocket; and (4) ERH thruster - rocket. The second section covers the following topics: (1) propagating LSD wave model for ERH thrusters; (2) mission implication on ERH thruster geometry; (3) alternatives for LSD wave ignition; (4) ERH thruster optical train alternatives; (5) ramjet/scramjet optical train alternatives. In section three, ERH thruster performance analysis is covered. Section four covers ERH thruster radiation heat transfer analysis and section five covers trajectory analysis. Section six lists future plans.

42906 (CONF-8710452–, pp. 209-224) **Controlling a pulsed laser-propelled vehicle.** Barrett, R.C. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA);

14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

Laser propulsion is a relatively new idea for delivering payloads to low earth orbit at a reasonable cost. The basic concept consists of generating thrust by heating some inert propellant with a ground-based laser. The removal of the power source from the vehicle and the ability to produce high specific impulses results in a high efficiency propulsion scheme. The problem of controlling the vehicle has not yet been addressed. Obviously one cannot simply point the laser into the air and expect the vehicle to ride upon it in a stable manner, nor is it useful to simply push the vehicle straight up. Thus the control system must maintain stability and allow control of the vehicle's trajectory. This problem, its analysis, and some of the design considerations are the subject of this paper. 11 figs.

42907 (CONF-8710452–, pp. 225-247) **Major physics and engineering issues for a small laser propulsion launch system.** Kare, J.T. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. In *1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion. Proceedings.* Source: NTIS, PC A11/MF A01.

A possible design for a near-term laser propulsion system for ground-to-orbit launch of small payloads has been discussed. A real launch system, however, would be very complex and would require extensive engineering. In an effort to pin down the amount and variety of work needed to develop such a launcher, the authors have selected a particular design and considered what would be needed to implement it. This system would use a 20-MW electric-discharge CO_2 laser and a 10-meter-diameter telescope to launch 20-kg payloads. The launch vehicles would use a double-pulse planar thruster with an inert propellant to provide approximately 2000 N (max) thrust at ranges up to approximately 1000 km; the thruster is assumed to provide 40% efficiency (exhaust kinetic energy/absorbed laser energy) at 800 seconds I_{sp}. The basic design of the system, while not necessarily optimum, was chosen to give low overall risk and low cost; for example, CO_2 laser technology is relatively well developed and inexpensive compared to FEL or other laser technologies. The long CO_2 wavelength also reduces the performance requirements for the rest of the system - in particular, problems of atmospheric transmission such as Raman conversion and turbulence-blooming interactions are greatly reduced. The following outline presents some of the major issues that will need to be resolved in order to build such a launch system. Particular approaches to solving some problems are suggested, along with particular tests or research projects needed. This outline was intended to be fairly inclusive, but is necessarily extremely sketchy, especially with respect to possible alternate solutions to problems. 5 refs., 1 fig.

42908 (DOE/CE/15449–T4) **Fuel savings in the heavy trucking industry through cool storage: Fourth technical progress report, March 20, 1990–June 19, 1990.** Instatherm Co., Cary, NC (USA). [1990]. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE15449. Order Number DE90013317. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is a progress report on the application of cool storage to fuel savings in the heavy trucking industry. 4 figs. (FSD)

42909 Iowa's statewide traffic signal improvement program. Maze, T.H. (Rural Technical Assistance Program, IA (US)); Graham, J.; Hawkins, N.; Elahi, M. *ITE (Institute of Transportation Engineers) Journal (USA),* 60(5): 27-31 (May 1990). Grant 87-0063-01.

New traffic signal equipment and traffic signal-timing plans were implemented in 19 Iowa cities as part of the $3 million Iowa Motor Vehicle Fuel Reduction Program (IMVFRP). The cities were evenly distributed in size (small-, medium-, and large-population communities) and evenly distributed geographically across Iowa. The signal improvements ranged from multi-intersection signal system to individual, isolated intersection signals. The application of varied technologies to cities evenly distributed with respect to population and location was another unique feature of the Iowa program. As a result of the IMVFRP, Iowa drivers will save approximately 280,000 gallons of fuel each year. A total of 299 intersections were improved within 19 Iowa cities.

42910 Autonomous land navigation in a structured environment. Klarer, P.R. (Sandia National Lab., Advanced Technology Div., Albuquerque, NM (US)). *IEEE Aerospace and Electronic Systems Magazine (USA),* 5(3): 9-12 (Mar 1990). DOE Contract AC04-76DP00789.

This paper describes a hardware and software system developed to perform autonomous navigation of a land vehicle in a structured environment. The vehicle used for development and testing of the system was the Jeep Cherokee Mobile Robotics Testbed Vehicle developed at Sandia National Laboratories in Albuquerque. Since obstacle detection and avoidance have not yet been incorporated into the system, a structured environment is postulated that presumes the paths to be traversed are free of obstacles. The system performs path planning and execution based on maps constructed using the vehicle's on board navigation system and map-maker. The system software, hardware and performance data are discussed.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 42333, 42658, 42849, 42917, 42919, 43134

42911 (DOE/CE/40865–1) **Recaustization of kraft black liquor via bipolar electrodialysis: Final report.** Koumoundouros, J.A.; Oshen, S.; Lynch, J.D. HPD, Inc., Plainfield, IL (USA). May 1990. 86p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-88CE40865. Order Number DE90014440. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The US Department of Energy in conjunction with HPD Inc. supported a research program to perform a laboratory feasibility study with various black liquor samples for the recaustization of these samples via bipolar electrodialysis. The research was conducted at the HPD pilot plant facility in Plainfield, Illinois, beginning in April 1989. This report is a summary of the work completed thru November 1989. The program was designed to operate the electrodialyzer in order to obtain performance and engineering data such as current efficiency, power consumption per gram of NaOH produced, and assess fouling and/or membrane durability. Prior to the electrodialysis laboratory runs, the black liquor samples were pretreated in order to remove as much lignin as possible. The black liquor samples were air oxidized, acidified to pH = 9.0 and pH = 2.0 and later filtered via a Buchner funnel under vacuum. The filtrate was then utilized to become the feed to the electrodialysis stack. Initial test runs were performed with synthetic solutions of either sodium sulfate or sodium bicarbonate in order to determine acceptable operating current, power, current efficiencies, and fouling behavior. A second set of test were conducted with a series of four Southern Kraft black liquor samples. Based on the results of this study, it was determined that the use of bipolar electrodialysis for producing a caustic stream and an acidified black liquor stream is feasible and was demonstrated. 9 refs., 27 figs., 32 tabs.

42912 (DOE/CH/10093–T19) **Preliminary feasibility study of pulping catalyst production from lignin.** Power, A.J. (Power (Arthur J.) and Associates, Boulder, CO (USA)); Bozell, J.J.; Chum, H.L. Power (Arthur J.) and Associates, Boulder, CO (USA); Solar Energy Research Inst., Golden, CO (USA). Nov 1989. 48p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90014194. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A preliminary evaluation of the economic feasibility of preparing anthraquinone, a pulping catalyst, from readily available lignin has been performed. The proposed process begins with a fractionation of lignin from a black liquor stream by means of a supercritical fluid or conventional solvent extraction to give a low molecular weight fraction conductive to further chemical treatment. This fraction is sequentially oxidized with H_2O_2, treated with a diene and dehydrogenated to give anthraquinone. The cost of the proposed process is most dependent on the overall yield of the chemical processing steps with a smaller contribution noted for lignin processing. The projections indicate that anthraquinone could be produced for as

low as $1.00–$1.25/lb using this process. Details of the process, chemical reactions and calculations are included.

42913 (DOE/CS/40158–20) **Inert anodes for aluminum smelting: Final report, September 29, 1980–September 30, 1985.** Weyand, J.D.; Ray, S.P.; Baker, F.W.; DeYoung, D.H.; Tarcy, G.P. Aluminum Co. of America, Alcoa Center, PA (USA). Alcoa Labs. Feb 1986. 576p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC07-80CS40158. Order Number DE90014989. Source: NTIS, PC A25/MF A01 - OSTI; GPO Dep.

The use of nonconsumable or inert anodes for replacement of consumable carbon anodes in Hall electrolysis cells for the production of aluminum has been a technical and commercial goal of the aluminum industry for many decades. This report summarizes the technical success realized in the development of an inert anode that can be used to produce aluminum of acceptable metal purity in small scale Hall electrolysis cells. The inert anode material developed consists of a cermet composition containing the phases: copper, nickel ferrite and nickel oxide. This anode material has an electrical conductivity comparable to anode carbon used in Hall cells, i.e., 150 ohm $^{-1}$cm^{-1}. Metal purity of 99.5 percent aluminum has been produced using this material. The copper metal alloy present in the anode is not removed by anodic dissolution as does occur with cermet anodes containing a metallic nickel alloy. Solubility of the oxide phases in the cryolite electrolyte is reduced by: (1) saturated concentration of alumina, (2) high nickel oxide content in the NiO-$NiFe_2O_4$ composition, (3) lowest possible cell operating temperature, (4) additions of alkaline or alkaline earth fluorides to the bath to reduce solubilities of the anode components, and (5) avoiding bath contaminants such as silica. Dissolution rate measurements indicate first-order kinetics and that the rate limiting step for dissolution is mass transport controlled. 105 refs., 234 figs., 73 tabs.

42914 (LIU-TEK-LIC–1990-18) **MIND. Optimization method for industrial energy systems.** Linkoeping Studies in Science and Technology. Nilsson, Katarina. Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering. Apr 1990. 64p. Order Number DE90512630. Source: NTIS (US Sales Only), PC A04/MF A01.

It is of great importance to encourage the consciousness of energy demand and energy conservation issues in industrial applications as the potential for savings in many cases is very good. The MIND optimization method is a tool for life cycle cost minimization of a flexible range of industrial energy systems. It can be used in analyses of energy systems in response to changes within the systems, changes of the boundary conditions and synthesis of industrial energy systems. The aim is to find an optimal structure in the energy system where several alternative process routes and kinds of energy are available. Equipment alternatives may concern choices of recondition, exchange, new tehnology, time of investment and size considerations. Energy can be supplied to the industrial energy system as electricity, steam and with various kinds of fuel. Energy and material flows are represented in the optimization as well as non-linearities in energy demand functions and investment cost functions. Boundary conditions and process variations can be represented with a time division where the length of each time step and the number of time steps can be chosen. Two applications are presented to show the flexibility of the MIND method, heat treating processes in the engineering industry and milk processing in a dairy. (36 refs.).

3206 Municipalities and Community Systems

Refer also to citation(s) 42378, 42624, 42678, 42679

42915 (BFR-R–18-1990) **An aquifer-based energy system: Preliminary study Edz Wiik.** Eriksson, A. (AIB Anlaeggningsteknik AB, Solna (SE)); Johansson, S.; Werner, G. Swedish Council for Building Research, Stockholm (Sweden). Dec 1989. 54p. (In Swedish). Project BFR- 880473-3. Order Number DE90512634. Source: NTIS (US Sales Only), PC A04/MF A01.

The technical, economic and environmental aspects fo an aquifer-based energy system for the project Edz Wiik have been studied. The project comprises three sports arenas (including two ice-sport arenas) and construction of apartment and office-buildings. The area is situated on an esker 100 m wide and 10-15 m deep below the ground water level. The calculated heat storage need of the system amounts to 6 GWh/year. The hydraulic conductivity of the aquifer is about 10^{-2} m/s, and will allow a high extraction and infiltration rate in the wells. The environmental impacts of an aquifer sytem will be smal than with conventional energy systems, due to a more efficient use of the energy produced in the system and to a lower total consumption of energy. The cost for the sytem will be 10-15% above that of a conventional system (an increase of about 0.65 M dollar), but the operational cost will be about 0.15 M dollar lower annually, calculated in the present energy prices.

42916 (CONF-900828–5) **Treatability tests on water from a low-level waste burial ground.** Taylor, P.A. Oak Ridge National Lab., TN (USA). [1990]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Summer national meeting of the American Institute of Chemical Engineers; San Diego, CA (USA); 19-22 Aug 1990. Order Number DE90015168. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Lab-scale treatability tests on trench water from a low-level waste burial ground have shown that the water can be successfully treated by existing wastewater treatment plants at Oak Ridge National Laboratory. Water from the four most highly contaminated trenches that had been identified to date was used in the treatability tests. The softening and ion exchange processes used in the Process Wastewater Treatment Plant removed Sr-90 from the trench water, which was the only radionuclide present at above the discharge limits. The air stripping and activated carbon adsorption processes used in the Nonradiological Wastewater Treatment Plant removed volatile and semi-volatile organics, which were the main contaminants in the trench water, to below detection limits. 6 refs., 2 figs., 7 tabs.

42917 (DOE/CE/26561–1) **Open cycle heat pump development for local resource use: Phase 2, District heating case study analysis: Final report, September 13, 1988–April 10, 1990.** Patch, K.D.; DiBella, F.A.; Glick, J.F.; Becker, F.E. TECOGEN, Inc., Waltham, MA (USA). Apr 1990. 91p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26561. (TR–4455-038-90). Order Number DE90011123. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

District heating (DH) systems provide thermal energy to their customers in the form of hot water or steam. These systems can use one or more types of heat sources to meet the thermal load, including boilers, cogeneration systems, or low-grade heat sources in conjunction with a heat pump. Most large-scale heat pumps operate using the closed-cycle concept and usually use a chlorinated fluorocarbon (CFC) as the working fluid. An alternative to this approach is the quasi open-cycle heat pump, which was first studied in a Phase 1 report entitled "Open-Cycle Heat Pump Development for Local Resource Use," DOE/CE/26563-5. The quasi open-cycle (QOC) heat pump actually uses the district heating transport medium as its working fluid. This document is the Final Report prepared as a part of Task 6 of Open-Cycle Heat Pump Development for Local Resource Use, Phase 2 District Heating Case Study Analysis. The objective of this study contract was to assess the application of the QOC heat pump in an actual case study. 43 figs., 11 tabs.

42918 (DOE/CE/26572–T1) **Waikiki District Cooling Utility, Honolulu, Hawaii: Project report.** Darrow-Sawyer and Associates, Inc., Honolulu, HI (USA); Makai Ocean Engineering, Inc., Waimanalo, HI (USA); Smith, Young and Associates, Inc., Honolulu, HI (USA). 20 Feb 1990. 52p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26572. Order Number DE90013006. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The use of cold seawater to replace water chilled by air conditioning and refrigeration compressors and their auxiliaries represents a cost effective savings applied to the largest single power in Waikiki. Of the 107 Megawatts used here, 51.4 are identifiable with air conditioning that is subject to energy reduction by the use of cold seawater. The project will consist of laying on ocean intake pipe a minimum of 48 inches in diameter approximately three miles offshore to a depth of 1680 feet. Water will be pumped to a

machine room which will house a bank of titanium plate heat exchangers and salt water and chilled water pumps. Here the salt water will cool fresh water which will be circulated through a district cooling system to users in Waikiki. A second seawater pipe will return the slightly warmed water approximately one mile offshore. The scope of the work covered by this application is to specifically attain greater detail into this already well accepted general plan using advanced district cooling and DOE technologies already accepted, so that construction costs and economics can be accurately ascertained. The ultimate goal being to obtain construction financing and have this project become a reality. 21 figs.

42919 (DOE/CE/26573–T1) **New Orleans district cooling system: Final report.** New Orleans City Government, LA (USA). 15 Mar 1990. 158p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26573. Order Number DE90011033. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The purpose of this study is to investigate the economic and energy saving potential of ammonia refrigeration for district cooling, as an alternate to equipment using CFC refrigerants. In order to be able offer a refrigeration machine that is safe to install inside a building, and is both low in capital cost and reasonably efficient, manufacturers have resorted to high speed centrifugal compressors to move the refrigerant. These machines have very narrow requirements for refrigerants. These machines are utterly dependent upon the particular CFC refrigerants that are slated for phase out by the year 2000 if not sooner. While the chemical industry is hard at work on replacements, it is highly unlikely that they will be able to produce a chemical that can be used in existing equipment. The most promising replacement refrigerant requires major modifications to existing machines. As a result, there is a real need for alternate means of producing refrigeration for cooling buildings. Ammonia refrigeration is a well developed, energy efficient way to produce cooling, with little of the environmental problems of the CFC refrigerants. While safety considerations restrict the use of ammonia in buildings, there should be few such restrictions on a central plant. This study compares the capital and operating costs of a new central cooling plant, remote from the buildings cooled, with the energy costs of operating the present cooling systems. 27 refs., 26 figs.

42920 (LUTMDN-TMVK–5186-1-14-1990) **Optimization of insulation thickness for district heating conduits.** Namazi, Amir. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Feb 1990. 16p. (In Swedish). Order Number DE90512594. Source: NTIS (US Sales Only), PC A03/MF A01.

Examination paper, includes minidisc.

The aim of the work is to provide recommendations for optimal insulation thicknesses for district heating pipes. A careful analysis is made of the initial costs and their parameter dependence, together with an estimate of the heat losses and their variation over the year. The heat loss cost and the initial costs are related to a typical production cost for district heating piping. The dependence of a transition to CFC-free insulation materials will be analyzed. As CFC-free material was chosen the CO_2-expanded product marketed by a Swedish culvert manufacture. By comparison between CO_2 and CFC-expanded materials it is shown that the former lead to a higer initial cost by 9-18%, depending on culvert dimension.

3209 Education and Public Relations

42921 Accelerating the adoption of energy saving technologies: The International Energy Agency's Center for the Analysis and Dissemination of Demonstrated Energy Technologies. Milhone, J.P. (Hagler, Bailly and Co., Washington, DC (USA)); Abel, F.; Snell, S.A. pp. 107-110 of Strategies for reducing natural gas, electric and oil costs. Association of Energy Engineers, Atlanta, GA (USA) (1990). (CONF-891028–: 12. world energy engineering congress, Atlanta, GA (USA), 24-28 Oct 1989).

Demand-side management serves to eliminate inefficient use of electricity while providing a plentiful and secure electrical supply. As a result of new energy-efficient technologies and energy conservation measures, the United States' total energy consumption in 1986 was actually less than it was in 1973. Approximately half of the reduced demand can be linked to technical improvements in vehicles, buildings and manufacturing equipment. While significant gains have been achieved, the potential for energy conservation through the more efficient use of natural gas, oil, and electricity is great. The authors discuss how achieving that potential is dependent upon the adoption and utilization of new, energy-efficient technologies.

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 42332, 42934, 42974, 42975, 43245, 43246, 43247, 43248

42922 (LUTFD2-TFRT–5419-1-63-1989) **Adaptive gain scheduling of a combustion engine.** Klinghult, G. Lund Univ. (Sweden). Dept. of Automatic Control. Dec 1989. 64p. (In Swedish). Order Number DE90512593. Source: NTIS (US Sales Only), PC A04/MF A01.

The project deals with developing of software in order to simulate adaptive gain scheduling of a combustion engine. The control algorithms will be used on a real engine. The purpose has been to obtain a system, which at given load will find the control parameters at which the engine gives the lowest possible consumption of fuel and values of emission. This means that the engine will optimize itself. The optimized adjustment of the parameters of the engine is stored. The more the engine is run, the more the system will learn about the engine and the better the engine will run. This also makes the system able to correct itself for such changes that are difficult to measure. Examples of this is wearing of the engine or variations of fuel quality.

42923 (ORNL–6612) **Influence of diesel engine exposure on the rupture strength of silicon nitride and partially stabilized zirconia.** Brinkman, C.R.; Begun, G.M.; Graves, R.L.; Kahl, W.K.; Liu, K.C.; West, B.H. Oak Ridge National Lab., TN (USA). Jun 1990. 26p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014759. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are reported from studies in which several monolithic ceramic materials in the form of modulus-of-rupture bars were exposed for 100 h to the combustion conditions found in either a small single- or two-cylinder diesel engine. Fuels included a standard Phillips D-2 diesel or a synthetic mixture of the Phillips D-2 and an aromatic blend. The ceramics included two commercial grades of partially stabilized zirconia: (1) PSZ-TS and (2) PSZ-MS and silicon nitride (GTE WESGO SNW-1000). Significant reductions in postexposure fracture strength occurred in the PSZ-TS material irrespective of whether it was exposed in the single- or two-cylinder engine. Only a small decrease in fracture strength occurred in the PSZ-MS material, and essentially no decrease in fracture strength occurred in the silicon nitride. 2 refs., 16 figs.

42924 (ORNL/Sub–84-00221/1) **Effect of environment upon mechanical behavior of structural ceramics for application in the DOE Ceramic Technology for Advanced Heat Engines Project: Final report, January 1985–December 1986.** Hecht, N.L. (Dayton Univ., OH (USA). Research Inst.); Graves, G.A.; McCullum, D.E.; Berens, A.P.; Goodrich, S.; Wolf, J.D.; Hoenigman, J.R.; Yaney, P.; Grant, D.; Hilton, S.; Jang, S.D. Oak Ridge National Lab., TN (USA); Dayton Univ., OH (USA). Research Inst. Jun 1990. 165p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014770. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The primary goal of this research was to determine the effect of environment upon toughening and strength in commercially available transformation-toughened ceramics [partially stabilized ZrO_2 (PSZ) and dispersion toughened Al_2O_3 (DTA)]. Emphasis was on understanding the mechanism(s) responsible for environmentally induced strength degradation in the temperature range of 25 to 1050°C. Dynamic fatigue techniques (four-point flexural strength as a function of stressing rate) were used in a three-phase plan to investigate fracture strength and slow crack growth in environments containing controlled amounts of water vapor. Similar measurements were also conducted in inert atmospheres (dry N_2) to

distinguish intrinsic effects from environmentally derived effects. In addition, the effects of aging (extended exposure at elevated temperatures and selected atmosphere conditions) on the candidate materials at low temperatures were studied. The activities pursued and the results obtained are described in this report. 40 refs., 53 figs., 22 tabs.

42925 Coal fueled diesel cycle simulation: The role of group effects. Branyon, D.P. (Texas A and M Univ., College Station, TX (USA). Dept. of Mechanical Engineering); Caton, J.A.; Annamalai, K. pp. 77-84 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

An existing coal-water slurry fueled diesel engine cycle simulation was modified to include the addition of particle -to-particle and droplet-to-droplet interactions during the combustion and vaporization processes. Two aspects of these interactions, known as group effects, were considered. Group effect number 1 (GE1) relates to the species concentrations and temperature profiles between particles during combustion and between droplets during vaporization. Group effect number 2 (GE2) relates to the blockage of air entrainment to the fuel region due to the large momentum flux of volatiles and CO during combustion or water vapor during vaporization. The major conclusions are that GE1 affected the detailed process characteristics and in-cylinder conditions, and moderately affected the overall engine performance for the cases studied.

42926 A comprehensive model for pilot-ignited, coal/water mixture combustion in a direct injection diesel engine. Wahiduzzaman, S. (Ricardo-ITI, Inc., Westmont, IL (US)); Blumberg, P.N.; Keribar, R.; Rackmil, C.I. pp. 59-68 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

A combustion model has been developed for a direct injected diesel engine fueled with coal/water slurry mixture (CWM) and assisted by diesel pilot injection. The model combines the unique heat and mass transport and chemical kinetic processes of CWM combustion with the normal in-cylinder processes of a diesel engine. It includes a two stage evaporation submodel for the drying of CWM droplet, a global kinetic submodel for devolatilization, and a char combustion submodel describing surface gasification by oxygen, carbon-dioxide and water vapor. The combustion volume is discretized into multiple zones, each of whose individual thermochemistry is determined by in-situ equilibrium calculations. This provides an accurate determination of the boundary conditions for the CWM droplet combustion submodels and the gas phase heat release. A CWM fuel jet development, entrainment and mixing submodel is used to calculate the mass of unburned air in each of the burned zones. A separate submodel of diesel pilot fuel combustion is incorporated into the overall model, as it has been found that pilot fuel is required to achieve satisfactory combustion under many operating conditions.

42927 Lube oil contamination induced wear in coal-fueled diesel engines. Schwalb, J.A. (Southwest Research Inst., San Antonio, TX (USA)); Ryan, T.W. III; Smith, W.C. pp. 51-58 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

Cylinder liner and ring wear caused by contamination of the lube oil are major problems associated with he use of coal/water slurries in diesel engines. The goal of this work was to define the effects of contaminants on wear rate, and to study the mechanisms by which contaminants accelerate wear. Particles with a range of 0 through 85 percent by mass ash contents were used to represent the possible contaminants in the lube oil of a coal-fired diesel engine. The contaminants were mixed with bright-stock lube oil and were used in a commercial friction and wear machine which simulates the reciprocating motion of the ring. These tests indicate that wear rates increased significantly when the oil contains 5 or 10 percent of a contaminant, but the wear was not influenced by ash content of the contaminant. When contaminant loading was increased to 15 percent, wear rates tended to increase with ash content. The mechanisms responsible for these accelerated wear rates are discussed and ideas for conventional lubricant solutions are introduced.

42928 Development of fuel injection and combustion systems for coal-water-slurry fueled diesel engines. Kakwani, R.M. (Adiabatics, Inc., Columbus, IN (USA)); Badgley, P.R.; Smith, W.C. pp. 41-50 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

This paper describes the development of two coal-water slurry (CWS) injection systems in conjunction with the thermal ignition combustion system (TICS) to achieve autoignition of CWS. The CWS injectors are electronically controlled, accumulator systems with servo-actuation of the injector and a fluidic injector with electronic controls. High speed solenoid valves control the CWS injection timing and duration for both injector types. Data is presented for two types of injection nozzles. Injector No. 1 uses a conventional diesel fuel nozzle with a conical seat needle valve and straight spray orifice. Injector No. 2 is a fluidic nozzle with a no moving part control valve and a vortex type spray nozzle.

42929 Combustion of coal-water slurry in a two-cycle diesel engine: Test system design. Uzkan, T. (General Motors Corp., La Grange, IL (USA). Electro-Motive Div.); Horton, C.E. pp. 23-30 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

As part of the heat engines program of the Department of Energy Office of Coal Technology, a coal-water slurry burning diesel engine test set-up is designed and operated. This paper describes the details of this engine test set-up with emphasis on the coal-water slurry storage system, slurry handling system and injection system. Some examples of the test data are also presented.

42930 Cooper-Bessemer coal-fueled engine system: Recent developments in durable components. Mayville, R.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)); Wilson, R.P. Jr.; Rao, A.K. pp. 17-22 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

Phase I of a five-year (1988-1993) proof-of-concept project to develop coal-fueled diesel engines is near completion. This paper reports many of the results of this research and development phase for work performed on durable components. Measured wear rates were reduced in the most critical components, the injection nozzle tip and the top compression ring by nearly two orders of magnitude. This was accomplished through the application of very hard materials, including monolithic ceramics. A design is discussed to incorporate these relatively brittle materials into nozzle components. Also discussed is the expected wear rate for the turbocharger blades and methods by which this wear can be reduced.

42931 Control of emissions in the coal-fueled diesel locomotive. Slaughter, D. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center); Cohen, M.; Samuel, E.; Mengel, M.; Gal, E. pp. 11-16 of Coal-fueled diesel engines 1990: Volume 12. Caton, J.A. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

This paper describes an experimental program that evaluates a number of methods which reduce the SO_2 and particulate emissions from a CWS-fueled diesel engine currently being developed for the GE-locomotive. Calcium and CuO sorbents were tested for the reduction of SO_2 while cyclones, metal fabric filters, and granular beds were tested for particulate removal. Significant reductions were measured when injecting calcium sorbent (either dry or wet) in the exhaust manifold. At a Ca/S atom ratio of 2, 40 percent of

the SO_2 is removed. SO_2 removal using calcium hydroxide premixed with the CWM fuel is reduced by only 25 percent at a similar Ca/S ratio. Results evaluating CuO indicate that SO_2 reduction is greater than 80 percent.

3303 Electric-Powered Systems

Refer also to citation(s) 42833, 42834

3307 Emission Control

Refer also to citation(s) 42931

42932 Material selection of ceramics for hot gas particle removal from coal-derived streams. Nakaishi, C.V. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US)); Holcombe, N.T.; Kothari, V.P. pp. 127-135 of Proceedings of the fossil fuel combustion symposium 1990: Volume 30. Singh, S.N. American Society of Mechanical Engineers, New York, NY (USA) (1990). (CONF-900102--: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

This paper discusses the selection of porous ceramic materials for hot gas particle removal devices being developed through various DOE sponsored projects. System analysis of various coal-based power systems has shown a marked advantage in using hot gas cleanup instead of conventional cold gas cleanup methods. Particle removal is a key factor in a successful hot gas cleanup system for all the advanced coal-based power systems now consideration. Highly efficient particle removal systems are required to prevent erosion of the gas turbine blades. In advanced coal-based power systems, the use of porous ceramic materials to remove particles from hot gas streams appears to be very promising. Ceramic materials being considered include aluminosilicate, cordierite, silicon carbide, and silicon nitride. Hot gas cleanup in coal-derived gas streams provides and extreme test for ceramic materials.

3308 Alternative Fuels

Refer also to citation(s) 42332, 42925, 42926

42933 (KTH-KTR--90-10) **Theoretical and experimental studies of the spark-ignition engine fueled by catalytically decomposed methanol.** Pettersson, Lars. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology. May 1990. 30p. Order Number DE90512632. Source: NTIS (US Sales Only), PC A03/MF A01.

Passenger cars are the major source of the air pollutants carbon monoxide, hydrocarbons and nitrogen oxides in Sweden. This thesis presents a study concerning the utilization of a fuel, which would reduce these disadvantages. Implications of choice of fuel on environment are discussed. The work presents a study using decomposed methanol, i.e., hydrogen and carbon monoxide, as a fuel for spark-ignition engines. The engine performance and emissions were studied by using mixtures of neat methanol and bottled gas in the H_2/CO molar ratio 2/1. Base-line data for comparison were collected by running the engine on neat methanol. A control system was developed and the strategy of regulation is presented. It was found that the efficiency was 15-20% higher in the load interval 10-60 Nm, compared to operation with neat methanol. The emissions of nitrogen oxides were very low. Both the experiments and the theoretical engine simulations indicated that the major advantage with the system was the possibility of utilizing lean combustion. This had a greater effect on efficiency than the raise in heating value caused by the endothermic decomposition reaction. The thesis also includes a review of the literature in the field, which summarizes the experimental efforts with methanol/hydrogen engines. A discussion concerning suitable catalysts for methanol decomposition is included in the text. Alcohol vehicles are not easily started at low ambient temperatures. A cold starting method for neat methanol engies has been studied. This includes the development of a catalytic cold start reactor which produces a noncondensible gas containing hydrogen and carbon monoxide. The heat for the decomposition reaction is supplied through partial oxidation of methanol and the heat transfer is maintained by the hot flue gases streaming through the catalyst bed.

42934 (ORNL/TM--11590) **Results from the fourth year of operation of the Federal Methanol Fleet at Lawrence Berkeley Laboratory.** West, B.H. (Oak Ridge National Lab., TN (USA)); McGill, R.N.; Hillis, S.L. Oak Ridge National Lab., TN (USA). Aug 1990. 32p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014741. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Lawrence Berkeley Laboratory has completed a fourth year of operation of five methanol vehicles for the Federal Methanol Fleet Project. Five comparable gasoline vehicles were involved in the project for the first three years, but were retired at the end of the third year. Approximately 25,000 miles were accumulated on the five methanol vehicles during the fourth year bringing the ten car total for all four years to nearly 310,000 miles. Fuel economy of the methanol vehicles was about the same as in previous years, while drivers' ratings of ease of starting and driveability declined. The cars required more frequent maintenance than in previous years, and the accumulation rates of wear metals in the engine oil continued to decline. 13 refs., 5 figs., 15 tabs.

35 ARMS CONTROL

Refer also to citation(s) 43233

42935 (PB--90-871260/XAB) **Terrorism. December 1974-May 1990 (A bibliography from the NTIS data base). Report for December 1974-May 1990.** National Technical Information Service, Springfield, VA (USA). Jun 1990. 142p. Source: NTISPC N01/MF N01.

Supersedes PB--89-871677.

This bibliography contains citations concerning political, psychological, and sociological studies of international and domestic terrorism, including activities in the Middle East, Europe, and North and South America. Terrorism and counter measures with respect to diplomacy, intelligence, law enforcement, military operations, and security systems are considered. Nuclear materials management regarding terrorist activities is also included. (This updated bibliography contains 296 citations, 20 of which are new entries to the previous edition.)

3501 Policy, Negotiations, and Legislation

Refer also to citation(s) 42936, 42937

3503 Verification

42936 (DOE/DP/70041--T1) **Monitoring technologies in conventional arms control verification: The CFE [Conventional Armed Forces in Europe] context.** Pounds, T.J. Science Applications International Corp., McLean, VA (USA). 6 Jun 1990. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC01-88DP70041. Order Number DE90014258. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document discusses the challenges of evaluating conventional military capabilities during the rapidly changing political conditions in Europe. Recommendations are made for the implement new technology to require and process date about current military conditions. (FSD)

42937 (UCRL-ID--104105) **Alternative interpretations of TTBT [Threshold Test-Ban Treaty] monitoring effectiveness.** Bradford, R.; Strait, R.S. Lawrence Livermore National Lab., CA (USA). 12 Jun 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014722. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The eventual submission of the Threshold Test-Ban Treaty (TTBT) for ratification and the implementation of the enhanced verification provided for by the treaty will force policy makers to address many important verification issues. Many of these issues are

directly linked to judgments about the effectiveness of the US system for monitoring Soviet compliance. Examples include: which verification measures to deploy for each Soviet test: how to combine the monitoring data from different verification measures; how to respond to the monitoring data; and, particularly relevant to the ratification process, what is the level of monitoring effectiveness provided by the enhanced verification. Perhaps the two measures that best characterize monitoring effectiveness are: the probability of not detecting (i.e., missing) a militarily significant Soviet violation should the Soviets evade the treaty; and the probability that the US will believe that the Soviets are violating the threshold when they are actually complying (i. e., a false alarm). These probabilities of missing a violation and of false alarm are not themselves basic measurements. They are derived by a set of calculations. While these calculations were never simple nor wholly uncontroversial, the enhanced verification provided by the treaty and the ratification process will likely bring them under additional scrutiny. In this report, several approaches to determining TTBT monitoring effectiveness using the probabilities of a missed violation and false alarm are presented. The different approaches are presented in order of increasing complexity, and the pros and cons of each approach are discussed.

36 MATERIALS

Refer also to citation(s) 43263

3601 Metals and Alloys

Refer also to citation(s) 42322, 42323, 42327, 42657, 42685, 42693, 42694, 42696, 42697, 42699, 42700, 42702, 42713, 42746, 42784, 42913, 43041, 43072, 43073, 43074, 43075, 43078, 43079, 43089, 43093, 43120, 43127, 43128, 43565

42938 (AD-A-220843/7/XAB) **Reply to coupled S- and D-wave states in the Thorium-Doped Heavy-Fermion Superconductor UBe13 by H. Pleiner and H. R. brand. Technical report.** Sahu, D.; Langner, A.; George, T.F. State Univ. of New York, Buffalo, NY (USA). Dept. of Chemistry. Mar 1990. 10p. (UBUFFALO/DC–90/TR-8). Source: NTIS, PC A02/MF A01.

We discuss the points raised by H. Pleiner and H. R. Brand concerning our earlier work on Ube(13) and thorium-doped UBe(13).

42939 (BNL–44830) **Measurement of localized corrosion using current density mapping.** Isaacs, H.S.; Davenport, A.J. Brookhaven National Lab., Upton, NY (USA). [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-891113–12: American Institute of Chemical Engineers annual meeting, San Francisco, CA (USA), 5-10 Nov 1989). Order Number DE90015086. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The techniques for measuring distributions of currents over electrode surfaces have been reviewed. Simulation of current distributions in solutions, based on the substituting of elemental areas by point current sources are presented. Examples of the application of the technique using vibrating probe electrodes to study localized corrosion are discussed. The examples are stress corrosion cracking of sensitized stainless steels and inhibitor action during pitting of aluminum. 18 refs., 5 figs.

42940 (CDTN-DETS-PD–009/83) **Development phase of corrosion program in aquatic ecosystems.** Moreira, P.A. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 7 Apr 1983. 30p. (In Portuguese). Order Number DE90635192. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Providences adopted to implantation of corrosion program in aquatic ecosystems, developed by CDTN, NUCLEN and FURNAS are presented. The area, the atmospheric exposition station of Angra dos Reis, the marine floating, the material to test specimen and its preparation are described. (C.M.).

42941 (CDTN-DETS-PD–010/82) **Preliminary version of corrosion program to be done among CDTN, NUCLEN and FURNAS.** Moreira, P.A.P. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 6 May 1982. 43p. (In Portuguese). Order Number DE90635193. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The corrosion at atmospheric exposition Program developed by CDTN (Centro de Desenvolvimento da Tecnologia Nuclear) in galvanized materials, that serve as model for implantation a similar Program in Angra dos Reis area is presented. A materials list that will be tested and necessary costs to project elaboration are still presented. (C.M.).

42942 (CONF-9007131–1) **Structure of metal overlayers by low energy alkali ion scattering: Cu/Ru(001) and Sn/Pt (111).** Overbury, S.H. (Oak Ridge National Lab., TN (USA)); Mullins, D.R.; Paffett, M.T.; Koel, B. Oak Ridge National Lab., TN (USA). [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 3. international conference on the structure of surfaces; Milwaukee, WI (USA); 9-12 Jul 1990. Order Number DE90014453. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Structural studies of metal adsorption on metals by incident angle dependent, low energy alkali ion scattering are presented for the systems of Cu on Ru(0001) and Sn on Pt(111). Cu forms well ordered islands which are pseudomorphic for two layers. Sub-monolayers of SN incorporate into the first Pt layer upon annealing, giving rise to a slightly buckled first layer. 6 refs., 4 figs.

42943 (DOE/ER/45169–T1) **Mechanisms of high temperature crack growth in metals and alloys: Final technical report.** Nix, W.D. Stanford Univ., CA (USA). Dept. of Materials Science and Engineering. Jan 1989. 202p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-84ER45169. Order Number DE90014934. Source: NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The high-temperature creep crack growth behavior of pure Cu, Cu–Sn alloy, and predamaged Cu has been investigated. The purposes of this study have been to understand the mechanisms of creep crack growth; to prove theoretical predictions with experimental studies; and eventually to predict the time to failure of high-temperature structural materials. High-temperature crack growth experiments have been conducted under various loading conditions with a computer-based data acquisition and control system. A model to describe creep crack growth in pre-damaged Cu has been developed. It is based on cavity growth by coupled diffusional and creep processes under the damage-modified stress field. High-temperature crack growth experiments have been carried out under cyclic loading conditions. 99 refs., 59 figs., 2 tabs.

42944 (IWGGCR–18, pp. 65-72) **Thermal stability and environmental compatibility of Inconel 617.** Kimball, O.F. (Oak Ridge National Lab., Oak Ridge, TN (USA). Metals and Ceramics Div.). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. Contract DE-AC03-80ET34034;Contract DE-AC05-84OR21400. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988*. Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The thermal stability and environmental compatibility of Inconel 617, a prime nuclear process heat steam reformer candidate alloy, are described in this paper. This commercially available wrought nickel-base alloy has excellent high-temperature strength but is subject to loss of toughness and ductility due to thermal instability. Work done to improve the thermal stability of this alloy is discussed. Room-temperature tensile and toughness data and microstructural information for Inconel 617 specimens exposed at elevated temperatures are presented. Preliminary data indicate that controlling the chemistry of Inconel 617 can provide a substantial improvement in thermal stability. Preliminary work to define the range of high-temperature gas-cooled reactor (HTGR) primary coolant compositions within which minimal deleterious gas/metal reactions occur with Inconel 617 is described. Within this gas chemistry range a stable surface oxide forms and only slight carburization occurs. In other gas chemistry ranges, rapid

carburization or decarburization can occur. The gas corrosion experiments discussed are part of a series of relatively short-term exposures to HTGR helium in which the effects of different H_2O concentrations (0.01 to 1.0 Pa) were determined as a function of the systematic variation of a second constituent (CO and CH_4 for this work) in the test gas. The composition of the basic HTGR helium was 40 Pa H_2, 4 Pa CO, 0.02 Pa CO_2, 2 Pa CH_4 in helium at 0.2 MPa. Two other CO levels (1 and 12 Pa) and one additional CH_4 level (0.63 Pa) were used in these experiments. Experimental exposure methods are discussed and the results of gas-metal interaction studies are presented. These results include carbon analyses and optical and scanning electron microscopy to determine the morphology and type of surface and subsurface microstructures. (author). 15 refs, 6 figs, 5 tabs.

42945 (IWGGCR–18, pp. 143-149) **Fracture mechanical characteristic values (J-integral) with transference to components (tubes) by an analytical method.** Ullrich, G. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)); Alder, H.P.; Huthmann, H.; Grueter, L. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

One characteristic value that describe the onset of stable crack growth is the J-integral, a method developed independently by Rice and Cherepanov. The J-integral should be independent of the geometry. Nevertheless, an experimental approach to obtain these values for different specimen types were performed by the application of the potential drop technique. This method is useful for plastic materials and elevated temperatures. A common discussed problem is the application of the J-integral values received from small specimens to components. In this contribution a comparison of results from experiments on tubes with optical detection and finite element calculations with those obtained from a simple analytical method is performed. It is shown that an excellent agreement is obtained. From that point of view the analytical method delivers a simple tool to estimate J-integral values from simple load versus load point displacement diagrams of small specimens and components which can be produced by a simple test machine. (author). 6 refs, 6 figs, 1 tab.

42946 (IWGGCR–18, pp. 149-156) **Fracture toughness of Alloy 800 H at room temperature.** Krompholz, K. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)); Ullrich, G.; Alder, H.P.; Gnirss, G.; Huthmann, H.; Roedig, M.; Schubert, F. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The objective of this work is to compare and assess equipment, test methods, and evaluation procedures being used for J-integral fracture mechanics testing. Long-range objectives are to recommend testing procedures, to improve confidence in test data, and to provide a basis for future programs. From the point of view that single specimen techniques revealed relatively large scatter by comparing test data from different laboratories, in this contribution an evaluation according to the multi specimen technique is presented applying different evaluation procedures. These results are compared with those obtained by the single specimen techniques (d.c. potential drop technique). From that a recommendation for the application of the ASTM designations to the J-R curve for Alloy 800 H is presented. (author). 8 refs, 6 figs, 4 tabs.

42947 (IWGGCR–18, pp. 168-181) **Comparison of mechanical and corrosion behaviour of Alloy 800 H and the new alloy AC 66.** Pelz, W. (Bergbau-Forschung GmbH, Essen (Germany, F.R.)); Schendler, W.; Weber, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

In coal gasification plants based on nuclear process heat, materials are subjected to high temperature corrosion in process gas atmosphere at 750 to 900 deg. C. The process gas consists of steam, CO, CH_4, CO_2 and, depending on the gasified coal, low or high H_2S-concentrations. The service problems can be divided as follows: 1. Gas-metal interaction: (a) high temperature corrosion; (b) sulphidation; (c) carburization; (d) internal oxidation or internal sulphidation. 2. Ash (slag)-metal interaction: (a) corrosion in molten salts; (b) erosion. 3. Mechanical loading: (a) embrittlement; (b) thermal fluctuations/strain fluctuations; (c) low cycle fatigue; (d) high temperature creep. Therefore materials for heat exchangers must be resistant to these types of high temperature corrosion and they should also have adequate creep rupture strength. Some commercial alloys and various model alloys were exposed to a process gas atmosphere to determine the corrosion behaviour and also stressed mechanically to investigate the interaction of high temperature creep behaviour and corrosion. The tests were carried out for a total period of 10,000 h and specimens were taken out after periods of 1000, 3000, 5000 and 10,000 h. A programme for the development of alloys was started with the aim of optimizing the chemical composition resulting in a good high temperature corrosion resistance and adequate mechanical properties, particularly high creep strength. However, the material must be such that it can be deformed to tubes. Compared with Incoloy 800, one of the new and optimized model alloys (30-32% Ni, 25-27% Cr, and Ce, Fe-balance) exhibits a very good corrosion resistance even when sulphur rich coal is gasified. The creep rupture strength at 900 deg. C is in the range of the creep strength for Incoloy 800. 29 figs.

42948 (IWGGCR–18, pp. 105-115) **Multiaxial creep of tubes of Alloy 800 and Alloy 617 at high temperature.** Penkalla, H.J. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Schubert, F.; Nickel, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

The deformation behaviour under multiaxial loading at temperature higher than 800 deg. C is strongly controlled by creep. For dimensioning and inelastic analysis the use of v. Mises theory and Norton's creep law for stationary creep are demonstrated for different combination of internal pressure and axial or torsional stress or strains. The experimental results are in satisfactory agreement with the theoretical predicted deformation behaviour if values for the coefficient k and n in Norton's creep law are used, which are close to the real creep resistance in the component. (author). 11 refs, 12 figs, 2 tabs.

42949 (IWGGCR–18, pp. 115-128) **Fatigue properties of nickel-base high temperature alloys for HTGRs.** Tsuji, H. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Dept. of Fuels and Materials Research); Nakajima, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

Strain controlled low-cycle fatigue tests were conducted at room temperature (RT) to 900 deg. C on nickel-base high-temperature alloys, namely Hastelloy X and its modified versions Hastelloy XR

and Hastelloy XR-II, which are candidate alloys for HTGR applications. The tests were conducted in the simulated HTGR helium environment with the exception of those conducted in air at RT. In those tests the examination was made on the effects of strain rate, hold time, aging and test temperature on fatigue properties. Decreasing the strain rate led to notable decreases in the fatigue life. Based on the stress-strain curves and the crack morphology, it was suggested that a considerable contribution of creep damage was included at lower strain rates. In the experiments with the trapezoidal strain waveform with different holding types, the fatigue life was found to be reduced most effectively in tensile hold-time experiments. From the observations of the crack morphology the strain holding in the compressive side was suggested to play the role of suppressing the initiation and the growth of internal cracks and/or cavities, and to cause crack branching. The fatigue lives of the aged (900 deg. C, 1000h) specimens were shorter than those of the solution annealed ones at test temperatures ranging from RT to 700 deg. C. The tendency became more pronounced under higher strain range conditions. The reduction in the fatigue life due to aging treatment, observed through the tests conducted at and below 700 deg. C, was closely related with the loss of tensile ductility, which was attributed to the precipitation of M_6C carbide along the grain boundaries which occurred during the aging. Fractographic features and crack morphology of the aged specimens fatigued at and below 700 deg. C were of brittle nature relative to those of the solution annealed ones fatigued in the same temperature range. (Abstract Truncated)

42950 (IWGGCR–18, pp. 189-196) **Development and validation of an improved creep-fatigue interaction rule for lifetime determination of high temperature components.** Lehmann, H.J. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)); Becker, M.; Luedeke, M. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Jun 1989. (CONF-8806156–: IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors, Cracow (Poland), 20-23 Jun 1988). In *High temperature metallic materials for gas-cooled reactors: Proceedings of a specialists meeting held in Cracow, 20-23 June 1988.* Order Number DE90635511. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

For design purposes and for lifetime assessments of components operating at elevated temperatures the creep-fatigue interaction rule is widely used. Although this rule does not provide sufficient results, its world-wide use is due to the simplicity of its application in connection with inelastic lifetime analyses. In view of this, the creep-fatigue interaction rule was improved. One significant shortcoming is the missing strain rate dependence on creep damage during a relaxation phase. The influence of the strain rate on the creep damage in a material is caused by different deformation modes. At high strain rates, motion and formation of dislocation dominates, whereas grain boundary sliding increases with decreasing strain rate. These deformation modes cause different creep damage. Since the strain rate during a relaxation phase correlates with holdtime, an interaction term c(t) was introduced, describing the fractional change of creep damage in dependence of timedependent damage due to fatigue, with time as variable. The interaction term c(t) represents a weight function for the differential creep damage $dt_{/t}$ and varies between zero and unity, nonlinear with respect to holdtime. The effect of the interaction term c(t) consist in a lower accumulated creep damage in comparison with the unmodified rule in the region of fast strain rates. This fact is an agreement with the experience, that dislocation controlled deformation is less damaging than grain boundary sliding. With increasing holdtime corresponding with decreasing interaction between creep and fatigue the term c(t) tends to unity. In case of pure creep the improved rule turns over to the modified one. The improved rule has been validated by evaluation of uniaxial low-cycle fatigue holdtime experiments. The following materials have been investigated: Inconel 617 (NiCr22Co12Mo); AISI 304ss (X6CrNi1811); 12%Cr-Mo-V-steel (X20CrMoV121). (Abstract Truncated)

42951 (Juel–2319) **Investigations of carbon diffusion and carbide formation in nickel-based alloys.** Schulten, R.; Bongartz, K.; Quadakkers, W.J.; Schuster, H.; Nickel, H. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. Nov 1989. 159p. (In German). Order Number DE90512794. Source: NTIS (US Sales Only), PC A08/MF A01.

The present thesis describes the carburization behaviour of nickel based alloys in heavily carburizing environments. The mechanisms of carbon diffusion and carbide precipitation in NiCr alloys with and without ternary additions of iron, cobalt or molybdenum have been investigated. Using the results of carburization experiments, a mathematical model which describes carbon diffusion and carbide formation, was developed. The simulation of the carburization process was carried out by an iterative calculation of the local thermodynamic equilibrium in the alloy. An accurate description of the carbon profiles as a function of time became possible by using a finite-difference calculation. (orig.).

42952 (KFK–4676) **Creep test in base material and welded specimens of X6CrNi 1811 (DIN 1.4948) steel in the frame of AUSOL program. Final report.** Schirra, M. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung); Heger, S.; Ritter, B.; Barroso, S.; Rivas, M. de las; Solano, R.R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung. May 1990. 75p. (In German). Order Number DE90512949. Source: NTIS (US Sales Only), PC A04/MF A01.

The program AUSOL (AUtenite SOLdado) encompasses the creep-tests carried out with the austenitic steel CrNi in the frame of the German-Spanish collaboration (KfK-CIEMAT). The material studied is the X6CrNi 1811 (DIN 1.4948) steel selected as structural material for the sodium-cooled fast breeder reactor SNR-300. They have been tested, based material and welded specimens, in the range 500-750deg C having reached experimental results up to 50.000 n. The results on creep-behaviour, time to rupture, ductility and the metallographic and fractographic studies are presented, taking into account the comparative behaviour between base material and welded specimens. The results of creep behaviour and time to rupture fit in a dispersion margin corresponding to this type of steel. As expected the ductility of welded specimens is lower than the corresponding one to welded joints. (orig.).

42953 (N–90-21836) **The temperature variation of hydrogen diffusion coefficients in metal alloys.** Danford, M.D. National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center. Apr 1990. 18p. (NASA-TM–100397;NAS–1.15:100397). Source: NTIS, PC A03/MF A01.

Hydrogen diffusion coefficients were measured as a function of temperature for a few metal alloys using an electrochemical evolution technique. Results from these measurements are compared to those obtained by the time-lag method. In all cases, diffusion coefficients obtained by the electrochemical method are larger than those by the time-lag method by an order of magnitude or more. These differences are attributed mainly to hydrogen trapping.

42954 (ORNL/FTR–3678) **[Advances in welding technology]: Foreign trip report, June 6, 1990–June 24, 1990.** Vitek, J.M.; Davis, S.A.; Goodwin, G.M. Oak Ridge National Lab., TN (USA). 12 Jul 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014992. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The travelers attended the First US-Japan Symposium on Advances in Welding Metallurgy and presented three invited papers. The conference consisted of 16 invited papers and covered a wide range of topics that are of interest to ORNL, including HSLA steels, stainless steels, and Al–Li alloys. Following the conference, the travelers visited several research laboratories in Japan and discussed common research interests, including intermetallic alloys, modeling of weld microstructural development, and microstructural aspects of single crystal welding.

42955 (ORNL/FTR–3691) **[Mechanical properties of intermetallic compounds and high-temperature materials]: Foreign trip report, June 14–July 2, 1990.** Liu, C.T. Oak Ridge National Lab., TN (USA). 27 Jul 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90015137. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the first C-MRS International Conference in Beijing, China, on June 18–22, 1990. While in China, the traveler gave the keynote talk entitled "Brittle Fracture and Ductility Improvement in Ordered Intermetallics" at the Symposium "Intermetallic Compounds and High-Temperature Materials." During the meeting period, the traveler visited the University of Science and Technology, Beijing, The Institute of Aeronautical Materials,and the Central Iron and Steel Research Institute, and presented talks on mechanical properties of ordered intermetallic alloys. After the conference, the traveler visited Shanghai Jiao-Tong University and gave a seminar on intermetallics and exchanged technical information in the area of boron-doped Ni_3Al alloys, titanium trialuminides, and molydisilicides.

42956 (PNL-SA–17095) **Radiation-induced spinodal-like decomposition of Fe-Cr-Ni alloys and its influence on electropolishing of microscopy disks.** McCarthy, J.M.; Garner, F.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE90015292. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The object of this effort is to provide an understanding of the factors which control the radiation-induced evolution of microstructure in structural alloys. Scanning electron microscopy was used as a tool to investigate the dependence on nickel content of radiation-induced spinodal-like decomposition in Fe-15Cr-XNi alloys. It appears that the relative resistance to swelling observed in the Invar compositional regime at 510°C is concurrent with spinodal-like decomposition. The influence of this phenomenon in prolonging the loop-dominated phase of dislocation evolution and also suppressing the onset of accelerated void growth has not yet been determined.

42957 (SAND–90-1099C) **Numerical simulation of a sample recovery fixture for high velocity impact: Studies at various impact velocities.** Norwood, F.R.; Graham, R.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9008125–1: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90014328. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Numerical results are presented for a model of the sample recovery fixture developed by Sawaoka to preserve powder samples subjected to high velocity impact. These results were obtained with the hydrocode CSQ, for an axisymmetric stainless steel recovery fixture which approximates the actual fixture. Results are presented for stainless steel impactors with impact velocities of 0.9, 1.3, 1.6, 1.9 and 2.5 km/sec, corresponding to typical velocities for a series of experiments. The results obtained for an impact velocity of 0.9 km/sec are used to illustrate focusing effects in rutile powder compacts. After impact, a planar shock wave propagates through the fixture until it reaches the rutile sample. Because the shock velocity is slower in the powder compact, the wave fronts outside the sample radius propagate at a faster speed than those inside the sample. This results in a radial pressure gradient at the edge of the rutile sample. For the 0.9 km/sec impact velocity case, the radial pressure gradient generates wave fronts at the edge of the sample that are almost parallel to the axial direction. The radial effects are the dominant features and account for pressures and temperatures much higher than those predicted by a one dimensional analysis. 5 refs., 4 figs.

42958 (UCRL-JC–103631) **Behavior of Al-Mg alloys in hot working and superplasticity.** McQueen, H.J. (Concordia Univ., Montreal, PQ (Canada). Dept. of Mechanical Engineering); Kassner, M.E. Lawrence Livermore National Lab., CA (USA). 27 Jun 1990. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9002135–1: 2. superplasticity in aerospace meeting, Anaheim, CA (USA), 18-22 Feb 1990). Order Number DE90015193. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Al-Mg alloys offer a wide range of behaviours during deformation in the warm and high temperature domains. Below 250°C, the alloys exhibit high rates of strain hardening and serrated yielding. Through atmospheres pinning dislocations and reducing dynamic recovery in the same way as a drop in SFE, the Mg gives rise to non-uniform, non-cellular, high density substructures. This raises the rate of recrystallization despite the drag on grain boundaries and also causes non-uniformity in grain size. Addition of Mn gives rise to large Al_6Mn particles which induce high misorientation cells in the adjacent matrix and lead to nucleation on annealing. Fine Al_6Mn particles stabilize the substructure and retard grain boundary migration. Alloys of 1 to 7% Mg exhibit creep domains of 3rd power stress dependence (strain rate sensitivity m=0.33) which results in tensile ductilities of 200–300% during which the large grains develop substructures. At 300–600°C (1–100 s^{-1}), 1 to 3% Mg alloys develop a substructure almost as recovered as Al, which gives rise to slightly raised strain hardening, to steady state regimes and to ultra-ductility in torsion. At levels of 5 to 7% Mg, dynamic recrystallization is observed in limited domains. In alloys with 2–7% Mg having 0.5–0.8 Mn, dynamic recrystallization initiates at large constituent particles. Such alloys can be rendered superplastic though grain refinement by particle enhanced discontinuous static recrystallization. In contrast, Al-10Mg containing Al_8Mg_5 particles dynamically precipitated during T.M.P. also becomes capable through continuous recrystallization of superplasticity at higher rates than those above. 88 refs., 11 figs., 2 tabs.

42959 **The effect of pressure on Am-Cm alloys.** Haire, R.G. (Oak Ridge National Lab., TN (USA)); Dabos, S.; Benedict, U.; Dufour, C. pp. 9, Paper NUCL 26 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC05-84OR21400. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Under pressure the first four transplutonium metals (Am-Cf) undergo two sequences of structural transformations and eventually their 5f electrons are forced to participate in the metallic bonding. The pressures required to bring about these changes and the particular structural sequence observed depend on which actinide is being studied. Significant differences in such behavior occur between Am and Cm metals (Z = 95 and 96). Alloys of these latter two elements have now been studied to determine how their behavior under pressure changes with compositions; that is, to determine the Am-Cm pressure phase diagram. The authors shall report the results of these Am-Cm alloy studies and compare them to data for the pure elements.

42960 **Ultrasonic characterization of texture.** Li, Y. (Ames Lab., IA (USA)); Thompson, R.B. pp. 83-90 of Nondestructive monitoring of materials properties. Holbrook, J.; Bussiere, J. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-881155–: Fall meeting of the Materials Research Society, Boston, MA (USA), 28 Nov - 3 dec 1988).

This paper proposes a technique to characterize texture of rolled plates of cubic crystallites. This technique uses information from ultrasonic velocities of high order plate mode to improve the estimation of orientation distribution coefficients (ODS's), especially W_{400}. Also discussed is the generalization of this technique to the case of hexagonal crystallites.

42961 **Utilization of ultrasonic measurements to quantify aging-induced material microstructure and property changes.** Doctor, S.R. (Pacific Northwest Lab., Richland, WA (USA)); Bruemmer, S.M.; Good, M.S.; Charlot, L.A.; Taylor, T.T.; Boyd, D.M.; Deffenbaugh, J.D.; Reid, L.D. pp. 143-150 of Nondestructive monitoring of materials properties: Volume 142. Holbrook, J.; Bussiere, J. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-881155–: Fall meeting of the Materials Research Society, Boston, MA (USA), 28 Nov - 3 dec 1988).

Many structural components are exposed to thermal environments that promote aging-induced changes in material microstructure and properties. The extent of these changes may lead to a reduction in the design safety factors and, as a worst case, premature failure of the component. In order to illustrate how nondestructive measurements can be used to indicate these changes, ultrasonic measurements were conducted on stainless steel. Specimens from a high-carbon, Type 304 stainless steel were subjected to various thermal treatments to introduce differing precipitation morphologies. Specimens were examined using transmission electron microscopy to quantify the size, density, and distribution of the precipitates formed. Ultrasonic measurements were performed to assess sensitivity to the change in precipitation levels. Shear-wave

birefringence provided the most consistent measurements for tracking precipitate morphology changes. Birefringence velocity differences increased as precipitate size and density increased on grain boundaries and as additional precipitates formed in the matrix. The ability to nondestructively monitor the precipitation process is important since susceptibility to environmentally assisted cracking and low-temperature embrittlement correlated with this microstructural change.

42962 The zirconium-tin system, with particular attention to the Zr_5Sn_3-Zr_5Sn_4 region and Zr_4Sn. Kwon, Young-Uk (Iowa State Univ., Ames (USA)); Corbett, J.D. *Journal of Physical Chemistry (USA),* 2(1): 27-33 (Jan-Feb 1990). DOE Contract W-7405-ENG-82.

The stoichiometric phases Zr_5Sn_3 and Zr_5Sn_4 (both $P6_3/mcm$, a = 8.4560 (7), c = 5.779 (1) Å and a = 8.7656 (7), c = 5.937 (1) Å, respectively) are obtained in high yield from powder sintering reactions of Zr and $ZrSn_2$ at 1000°C. Arc-melted samples over the same composition range give generally complex and diffuse Guinier powder patterns, indicative of continuous distributions of compositions between the maximum melting $\approx Zr_5Sn_{3.3}$ (Zr_5Sn_3'') and either Zr_5Sn_3 or $\approx Zr_5Sn_4$. The arc-melted samples do not improve significantly on annealing at 1000-1100°C, although the line phases are recovered if the samples are first ground and pelleted. We propose a phase diagram for this region in which the limiting phase fields Zr_5Zn_3 and Zr_5Sn_4 merge at high temperature and exhibit a common melting maximum. The overall behavior doubtlessly derives from the close structural relationship between Zr_5Sn_3 and Zr_5Sn_4, the latter (Ti_5Ga_4 type) being an interstitial tin derivative of the former (Mn_5Si_3 type). The structure of a single crystal that grew from arc-melted Zr_5Sn_3 was shown to have the intermediate composition $Zr_5Sn_{3.18}$, consistent with the proposed relationships and structures (a = 8.5036 (9), c = 5.820 (1) Å, R/R_w = 1.7/2.0%). The zirconium-richest compound in this system is a line phase with a composition between $Zr_{4.0}Sn$ and $Zr_{4.1}Sn$. The compound shows weak superstructure reflections that require a doubled cell (a = 11.252 (1) Å) and a more complex structure than the assigned A15 type. Zr_4Sn slowly decomposes to α-Zr(Sn) and Zr_5Sn_3 at 820°C.

42963 Structural investigation of lithium-ammonia intercalation compounds of TiS_2. Young, V.G. Jr. (Arizona State Univ., Tempe (USA)); McKelvy, M.J.; Glaunsinger, W.S.; Von Dreele, R.B. *Journal of Physical Chemistry (USA),* 2(1): 75-81 (Jan-Feb 1990). DOE Contract W-31-109-ENG-38 ;W-7405-ENG-36.

The structures of two lithium-ammonia intercalation compounds of TiS_2 have been determined by Rietveld refinement of time-of-flight neutron powder diffraction data taken at 300 and 12 K. $Li^+_{0.23}(ND_3)_{0.63}TiS_2^{0.23-}$ and $Li^+_{0.11}(ND_4^+)_{0.11}(ND_3)_{0.54}TiS_2^{0.22-}$ are best described as 3R polytypes in the $R\bar{3}m$ space group throughout the temperature range investigated. The former compound has a = 3.4234 (1) Å and c = 26.8235 (13) Å at 300 K and a = 3.41213 (8) Å and c = 26.4921 (11) Å at 12 K, whereas the latter material has a = 3.42064 (9) Å and c = 26.7754 (12) Å at 300 K and α = 3.40928 (9) Å and c = 26.4471 (13) Å at 12 K. Available evidence strongly suggests lithium is coordinated to three ammonia molecules in the van der Waals gap of the former compound. The ammonia molecules are distorted from their normal pyramidal geometry in trigonal prismatic sites and have their pseudo-C_3 axes parallel to the TiS_2 sheets. The distance from nitrogen to the deuterium plane for ammonia increases with increasing Li^+ concentration. The ammonium cation is spherically disordered in trigonal prismatic sites. The substitution of ND_4^+ for Li^+ results in a contraction of the TiS_2 octahedra parallel to the host layers and an elongation of the octahedra perpendicular to the host layers. These compounds exhibit an anisotropic strain of ≈ 0.18% along the (001) direction and essentially no strain perpendicular to (001).

42964 A comparison of the solidification behavior of Incoloy 909 and Inconel 718. Cieslak, M.J. (Process Metallurgy Div., Sandia National Lab., Albuquerque, NM (US)); Knorovsky, G.A.; Headley, T.J.; Romig, A.D.; Kollie, T. *Metallurgical Transactions, A (Physical Metallurgy and Materials Science) (USA),* 21(2): 479-488 (Feb 1990).

The solidification behavior of two commercial aerospace superalloys, Incoloy 909 and Inconel 718, has been examined. Differential thermal analysis (DTA) revealed that Incoloy 909 terminates solidification with the formation of a single minor constituent at ≈ 1198°C. Inconel 718 terminates solidification with the formation of two minor constituents at ≈ 1257°C and ≈ 1185°C, respectively. Metallography confirmed that a single minor constituent was present in Incoloy 909 while two minor constituents were present in Inconel 718. Samples were also examined by electron probe microanalysis to reveal the patterns of elemental segregation.

42965 Planar 20-electron osmium imido complexes. A linear imido ligand does not necessarily donate its lone pair of electrons to the metal. Anhaus, J.T. (Massachusetts Institute of Technology, Cambridge (USA)); Kee, T.P.; Schofield, M.H.; Schrock, R.R. *Journal of the American Chemical Society (USA),* 112(4): 1642-1643 (14 Feb 1990).

The authors have been using the (2,6-diisopropylphenyl)imido ligand as a stabilizing ligand for high-oxidation-state Mo alkylidene, W alkylidene, Re alkylidene, and Re alkylidyne complexes. In order to explore the potential of a similar approach to the high-oxidation-state organometallic chemistry of later metals, and in view of the relative scarcity of imido complexes of group 8 and 9 metals, we have begun to explore the preparation and chemistry of new imido complexes of osmium, the metal that yielded the first example of a transition-metal imido complex, $Os(N\text{-}t\text{-}Bu)O_3$.

42966 X-ray absorption edge spectroscopy of ligands bound to open-shell metal ions: Chlorine K-edge studies of covalency in $CuCl_4^{2-}$. Hedman, B. (Stanford Univ., CA (USA)); Hodgson, K.O.; Solomon, E.I. *Journal of the American Chemical Society (USA),* 112(4): 1643-1645 (14 Feb 1990).

Information on electronic structure can be obtained from analysis of x-ray absorption edge spectra. This approach has been used to obtain information from edges of transition metals like Cu, Fe, Ni, and Mo. It is also possible to directly study the absorption edge of ligands such as Cl and S bound to the metal. These edges fall in the 2-3-keV energy region where edge features are very well resolved. We report here the observation of an intense preedge transition associated with ligands bound to open-shell central atoms. We further show that the properties of these preedge features can be used to probe covalency in metal-ligand bonding. We have studied the ligand K edge of chlorine complexes of Cu and Zn: Cs_2CuCl_4, bis(creatininium)$CuCl_4$, and Cs_2ZnCl_4. The Cu site in Cs_2CuCl_4 is distorted tetrahedral (D_{2d}), and the Zn site in Cs_2ZnCl_4 is isostructural. Bis(creatininium)$CuCl_4$ has a square-planar (D_{4h}) geometry. X-ray absorption spectroscopy (XAS) edge data were measured at the Stanford Synchrotron Radiation Laboratory by using methodology that has been previously described.

42967 Solution and solid-state characterization of europium and gadolinium Schiff base complexes and assessment of their potential as contrast agents in magnetic resonance imaging. Smith, P.H. (Los Alamos National Lab., NM (USA)); Brainard, J.R.; Morris, D.E.; Jarvinen, G.D.; Ryan, R.R. *Journal of the American Chemical Society (USA),* 111(19): 7437-7443 (13 Sep 1989).

Two lanthanide Schiff base macrocyclic complexes, $LnAM(OAc)_2Cl\text{-}4H_2O$ (Ln = Eu, Gd; HAM - HexaAzaMacrocycle = $C_{22}H_{26}N_6$), have been characterized in view of the potential of the Gd complex as a magnetic resonance imaging (MRI) contrast agent. The relaxivity of $GdHAM(OAc)_2Cl$ was measured at 300 and 20 MHz and is as high as that for the gadolinium aquo ion. The number of coordinated waters, q, was measured by comparison of the luminescent lifetimes of $EuHAM(OAc)_2Cl$ in H_2O and D_2O and found to be between three and four. The complex $GdHAM(OAc)_2Cl\text{-}4H_2O$ was characterized by single-crystal X-ray diffraction. The complex crystallizes in space group $P\bar{1}$ with Z = 2, a = 10.032 (2) Å, b = 12.765 (2) Å, c = 13.668 (3) Å, α = 69.190° (9)°, β = 72.405° (9)°, and γ = 74.07° (1)°.

42968 Conversion of epoxides to rhodium enolates: Direct evidence for a mechanism involving initial C-H activation. Wu, Jianxin (Lawrence Berkeley Lab., CA (USA)); Bergman, R.G. *Journal of the American Chemical Society (USA),* 111(19): 7628-7630 (13 Sep 1989). DOE Contract AC03-76SF00098.

The authors wish to report the reaction of a low-valent metal complex with ethylene oxide that is phenomenologically related to metal-induced oxirane reactions reported earlier. However, in the

present case direct detection of an intermediate demonstrates that the reaction takes place by initial C-H activation, rather than by attack at a ring C-O bond, leading to a metalated oxirane. In addition, we have found that conversion of the metalated intermediate to the final reaction product, a C-bond rhodium enolate, involves predominant 1,2-rearrangement of hydrogen rather than rhodium.

42969 Crystal structure of the expanded-metal compound $^7Li(ND_3)_4$. Young, V.G. Jr. (Arizona State Univ., Tempe (USA)); Glaunsinger, W.S.; Von Dreele, R.B. *Journal of the American Chemical Society (USA),* 111(26): 9260-9261 (20 Dec 1989).

The structure of the expanded-metal compound $Li(ND_3)_4$ has been one of the most important and elusive unsolved problems in metal-ammonia chemistry. This unique compound has the lowest melting point of any known metal (89 K) possesses unusual electrical and magnetic properties, and is just on the metallic side of the metal-nonmetal transition. The elucidation of the structure of $^7Li(ND_3)_4$ above the antiferromagnetic transition temperature is the subject of this investigation. These results confirm the idealized model proposed by Stacey and Sienko.

42970 Electromagnetic confinement and movement of thin sheets of molten metal. Lari, R.J.; Praeg, W.F.; Turner, L.R. To Dept. of Energy, Washington, DC (USA). USA Patent 4905756/A/. 6 Mar 1990. Filed date 18 Oct 1988. USA Patent Application 7-259,389. Int. Cl. B22D 27/02. 16p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an apparatus capable of producing a combination of magnetic fields that can retain a metal in liquid form in a region having a smooth vertical boundary including a levitation magnet that produces low frequency magnetic field traveling waves to retain the metal and a stabilization magnet that produces a high frequency magnetic field to produce a smooth vertical boundary. As particularly adapted to the casting of solid metal sheets, a metal in liquid form can be continuously fed into one end of the confinement region produced by the levitation and stabilization magnets and removed in solid form from the other end of confinement region. An additional magnet may be included for support at the edges of the confinement region where eddy currents loop.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 42327, 42823, 42913, 42923, 42924, 42957, 42991, 42996, 43010, 43060, 43136, 43218, 43222, 43225, 43597

42971 (DOE/ER/45357–3) **Defects and transport in mixed oxides: Progress report.** Dieckmann, R. Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering. 5 Jan 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER45357. Order Number DE90014663. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Short communication. MANGANESE OXIDES/diffusion; IRON OXIDES/diffusion; PROGRESS REPORT; SPINELS; DIFFUSION; VACANCIES; ELECTRIC CONDUCTIVITY

42972 (N–90-21843) **Studies on the use of supercritical ammonia for ceramic nitride synthesis and fabrication.** Cornell, L.; Lin, Y.C.; Philipp, W.H. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1990. 17p. (NASA-TM–102570;E–4441;NAS–1.15:102570). Source: NTIS, PC A03/MF A01.

The extractability of ammonia halides (including ammonium thiocyanate) formed as byproducts from the synthesis of Si(NH)2 via ammonolysis of the corresponding silicon tetrahalides using supercritical NH_3 as the extraction medium was investigated. It was found that the NH_4SCN byproduct of ammonolysis of Si(SCN)4 can be almost completely extracted from the insoluble Si(NH)2 forming a promising system for the synthesis of pure Si(NH)2, one of the best precursors for Si_3N_4. In addition it was found that Si_3N_4, AlN, BN, and Si(NH)2 are insoluble in SC ammonia. Also discussed are design considerations for a supercritical ammonia extraction unit.

42973 (N–90-22421) **Growth and patterning of laser ablated superconducting $YBa_2Cu_3O_7$ films on $LaAlO_3$ substrates.** Warner, J.D.; Bhasin, K.B.; Varaljay, N.C.; Bohman, D.Y.; Chorey, C.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 8p. (NASA-TM–102436;E–5205;NAS–1.15:102436;CONF-8910439–: 36. national symposium and topical conference, Boston, MA (USA), 23 Oct 1989). Source: NTIS, PC A02/MF A01.

A high quality superconducting film on a substrate with a low dielectric constant is desired for passive microwave circuit applications. In addition, it is essential that the patterning process does not effect the superconducting properties of the thin films to achieve the highest circuit operating temperatures. YBa2Cu3O7 superconducting films were grown on lanthanum aluminate substrates using laser ablation with resulting maximum transition temperature (T sub c) of 90 K. The films were grown on a LaAlO3 which was at 775 C and in 170 mtorr of oxygen and slowly cooled to room temperature in 1 atm of oxygen. These films were then processed using photolithography and a negative photoresist with an etch solution of bromine and ethanol. Results are presented on the effect of the processing on T_c of the film and the microwave properties of the patterned films.

42974 (ORNL/FTR–3675) **[Mechanical testing activities related to high-performance structural ceramics]: Foreign trip report, June 20, 1990–July 2, 1990.** Ferber, M.K. Oak Ridge National Lab., TN (USA). 17 Jul 1990. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014299. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler visited the Deutsche Forschungsanstalt fuer Luft- und Raumrahrt (DLR) to discuss their current mechanical testing activities related to high-performance structural ceramics. These discussions focused on a novel gripping arrangement for high-temperature tensile testing of single-phase and composite ceramics, which is particularly relevant to the tensile testing efforts in the Metals and Ceramics Division at ORNL. The 7th CIMTEC World Ceramics Congress in Montecatini Terme, Italy, consisted of papers on both classical and advanced technical ceramics. Papers of particular significance to the materials effort at ORNL covered both processing and property evaluation of advanced single-phase and composite ceramics. The pertinent material systems discussed included silicon carbide whisker- and particulate-reinforced silicon nitride; silicon carbide whisker- and particulate-reinforced zirconia; and silicon carbide whisker-reinforced alumina.

42975 (ORNL/FTR–3677) **[Ceramic materials and processing technology]: Foreign trip report, June 20–July 2, 1990.** Tiegs, T.N. Oak Ridge National Lab., TN (USA). 17 Jul 1990. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90014321. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler visited both the Federal Republic of Germany (FRG) and Italy. In the FRG, discussions were held with representatives of the Deutsche Forschungsanstalt fuer Luft-und Raumfahrt (DLR) in Cologne on advanced ceramic materials and processing technology. Composite materials based on silicon nitride and mullite matrices are being developed at that institute for aerospace applications. Because of personnel changes, the present staff at DLR has little experience in processing of silicon nitride by their patented hot-isostatic-pressing encapsulation technique. The traveler subsequently attended the 7th World Ceramics Congress, in Montecatini Terme, Italy, where he presented a poster on the high-temperature strength of silicon nitride and sialon composites. Topics of interest at the conference included presentations on ceramic fibers, ceramics produced by reaction of metal particles, toughening mechanisms, and advanced heat engine materials.

42976 (UCRL–101769) **Damage resistant optical coatings prepared using high temperature, plasma chemical-vapor-deposition.** Campbell, J.H. (Lawrence Livermore National Lab., CA (USA)); Emmett, J.L.; Brusasco, R.M.; Rainer, F.; Kersten, R.Th.; Paquet, V.; Etzkorn, H.W. Lawrence Livermore National Lab., CA (USA). 2 May 1990. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8911192–5: 1989 Boulder damage symposium, Boulder, CO (USA), 1-3 Nov 1989). Order Number DE90015042. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Multilayer dielectric optical coatings, nominally consisting of 1000 or more optical-quarterwave layers, have been prepared by reacting $SiCl_4$ and a halogenated dopant (e.g. $GeCl_4$) with O_2 in a microwave-driven plasma. The dopant concentration is such that the index difference (Δn) between adjacent quarterwave layers is about 0.02 or less. The deposition is carried out at high substrate temperatures (850 to 1100°C) producing a fully dense, fused silica coating. Surface damage thresholds of high reflectivity (HR) coatings prepared by this plasma process are comparable to those for fused silica. For example, at 1.06 μm and 16-ns we measure surface damage thresholds greater than 45 J/cm^2 compared to about 45–60 G/cm^2 for super-polished optical fused silica. 25 refs., 12 figs., 1 tab.

42977 Synthesis, x-ray diffraction, and magnetic susceptibility of Cm_7O_{12} with ^{248}Cm. Morss, L.R. (Argonne National Lab., IL (USA)); Williams, C.W.; Edelstein, N.M.; Shalimoff, G.V. pp. 9-10, Paper NUCL 27 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The magnetic susceptibilities of Cm(IV) compounds (CmO_2, CmF_4, and $BaCmO_3$) all show Curie-Wiess dependence much larger than that expected for the $5f^7$ ($^7F_0$) Cm^{4+} ion. It is possible that these compounds contain substantial amounts of Cm^{3+} (7.94 μ_B). Since thermogravimetry indicates that M_7O_{12} (M = Ce, Pr, Tb, Cm, Cf) are stable phases over a range of temperatures and pressures, the authors have prepared Cm_7O_{12} using the long-lived isotope ^{248}Cm ($t_{1/2}$ 340,000 y) by quenching a sample equilibrated at 550°C and 2 torr O_2. Magnetic susceptibility measurements on a 9-mg sample of this oxide show Curie-Weiss behavior between 20 and 298 K with μ_{eff} = 6.2 μ_B.

42978 Mass spectrometric studies of laser damage in calcium fluoride. Nogar, N.S. (Chemical and Laser Sciences Div., Los Alamos National Lab., Los Alamos, NM (US)); Apel, E.C.; Estler, R.C. pp. 42-49 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Both electron impact- and laser ionization-mass spectrometry have been used to probe the material spalled from CaF_2 surfaces by the fundamental (1.06μ) and harmonic (355 nm and 266 nm) outputs from a Q- switched Nd:YAG laser. The authors have identified a number of gas phase products, including Ca, CaF and tentatively CaF_2, and have measured their translational and internal energy distributions. Their results suggest that while the 1.06μ experiments can be adequately modeled in terms of a single damage mechanism (likely avalanche breakdown), the short-wavelength results suggest the onset of second mechanism, perhaps multiphoton absorption. This is consistent with both the observed bimodal velocity distribution following short-wavelength damage, and with the decrease in CaF vibrational and rotational excitation.

42979 An investigation of laser processing of thin film coatings. Weber, A.J. (Air Force Weapons Lab., Kirtland Air Force Base, NM (US)); Stewart, A.F.; Exarhos, G.J. pp. 289-296 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

This paper reports on experiments conducted to determine the practicality of laser processing of thin film coatings. A high average power CO_2 laser was used to flood load the entire surface of each test sample. Thin film coatings of HfO_2 and MgF_2 on fused silica substrates were irradiated with power densities between 25 and 125 W/cm^2. Extensive pre- and post-test characterization revealed that some changes in the microstructure were observed, the coating optical thickness was reduced and short wavelength transmission was improved.

42980 1064 nm and 350 nm laser damage thresholds of index oxide films deposited from organic solutions and sols. Thomas, I. (Lawrence Livermore National Lab., Livermore CA (US)); Wilder, J.; Gonzales, R.; George, D. pp. 361-364 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

High index optical coatings of the oxides TiO_2, Ta_2O_5, ZrO_2 and HfO_2 have been prepared from solutions of metal organic precursors and from colloidal oxide suspensions. Room temperature processing gives porous coatings of comparatively low refractive index (1.8-1.9). Heat treatments can, in some cases, increase the index. Laser damage threshold levels at 1064 nm with a single 1 ns pulse are in the range 6-10 J/cm^2, which is comparable with coatings of the same materials produced by electron beam evaporation. Lower figures are obtained at 350 nm with a 25 ns pulse under multishot (25 Hz) conditions.

42981 Chemical vapor deposition of TiO_2 thin films at room temperature. Wilder, J. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Thomas, I. pp. 387-391 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). DOE Contract W-7405-ENG-48. (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

This paper reports titania coatings prepared using a chemical vapor deposition (CVD) apparatus at room temperature. Coating were deposited by the reaction of gaseous $TiCl_4$ and H_2O at the substrate surface. High refractive indices were obtained with damage thresholds to 12.9 J/cm^2, at 1.06 μm, 1 ns.

42982 An investigation of laser processing of silica surfaces. Weber, A.J. (Air Force Weapons Lab., Kirtland Air Force Base, NM (US)); Stewart, A.F.; Exarhos, G.J.; Stowell, W.K. pp. 542-556 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

An initial set of experiments has been conducted to determine the practicality of laser processing of optical substrates. In contrast to earlier work, a high average power CO_2 laser was used to flood load the entire surface of each test sample. Fused silica substrates were laser polished on both surfaces at power densities ranging from 150 to 350 W/cm^2. During each test sequence sample surface temperatures were recorded using a thermal imaging system. Extensive pre- and post-test characterization revealed that surface roughness and scattering of bare silica surfaces were reduced while internal stress increased. Laser damage thresholds were found to increase only for certain conditions. Changes in the microstructure were observed. These preliminary experiments demonstrate that laser processing can dramatically improve the optical properties of fused silica substrates.

42983 Electrochemical processes in recovering metals from ores. Felker, D.L. (Hypalon Technical Polymer Product Dept., DuPont, Beaumont, TX (US)); Bautista, R.G. *JOM (1989) (USA)*, 42(4): 60-63 (Apr 1990).

Chalcopyrite ($CuFeS_2$) is one of the most abundant copper-bearing minerals in the U.S. Oxidative leaching and smelting and refining are the most common methods used for recovering copper from chalcopyrite. One of the problems associated with oxidative leaching is the formation of an elemental sulfur product layer around the unreacted chalcopyrite core. The sulfur coating slows the reaction by inhibiting both the diffusion of the oxidant to the unreacted core, and the diffusion of the copper and iron species to the bulk solution. Another problem with leaching is that the iron and copper are oxidized simultaneously. Both appear in the bulk solution in their most oxidized states. The direct electrodissolution of copper sulfide ore slurries could reduce the number of steps involved in the copper recovery process, possibly leading to significant reductions in energy consumption and operating costs. The potential application of electrodissolution processes in hydrometallurgy has been reviewed. This paper reviews investigations of the

electrochemical dissolution of chalcopyrite, digenite ($Cu_{1.8}S$), chalcocite (Cu_2S) and covellite (CuS).

42984 Isolation and structural characterization of the copper-barium-alkoxide cluster $Ba_2Cu_2(OR)_4(acac)_4 \cdot 2HOR$ (R = $CH_2CH_2OCH_3$) from precursor solutions to $YBa_2Cu_3O_7$ thin films. Sauer, N.N. (Los Alamos National Lab., NM (USA)); Garcia, E.; Salazar, K.V.; Ryan, R.R.; Martin, J.A. *Journal of the American Chemical Society (USA)*, 112(4): 1524-1528 (14 Feb 1990).

Attempts to identify intermediates in a solution route to thin films of the high-temperature superconductor $YBa_2Cu_3O_7$ have led to the isolation of the mixed-metal cluster $Ba_2Cu_2(OR)_4(acac)_4 \cdot 2HOR$ (R = $CH_2CH_2OCH_3$) (1). This compound, which is the first example of a molecular barium-copper cluster, was isolated from the reaction of the copper dimer $[(acac)Cu(OCH_2CH_2OCH_3)]_2$ with barium 2-methoxyethoxide, the first stage in the preparation of the thin-film precursor solution. Crystallographic data for 1 are as follows: formula = $Ba_2Cu_2O_{20}C_{36}H_{72}$, FW = 1250.5 g/mol, D_x = 1.57 g/cm^3, space group = $P\bar{1}$, a = 10.797 (3) Å, b = 11.269 (1) Å, c = 12.109 (1) Å, α = 106.18 (1)°, β = 100.93 (2)°, γ = 102.98 (2)°, Z = 1, R = 0.031 for 4059 reflections with $I \geq 2\sigma(I)$ and $2\theta \leq 50°$. Thin films prepared from this route showed superconducting transition temperatures of 85 K, only small amounts of impurity phases by X-ray powder diffraction, and $\leq$ 0.1 atom % carbon as determined by nuclear reaction analysis.

42985 Synthesis, structure, and applications of transition-metal polyhydride anions. Evans, W.J. (Univ. of California, Irvine (USA)); Caulton, K.G.; Alvarez, D. Jr.; Lundquist, E.G.; Ziller, J.W. *Journal of the American Chemical Society (USA)*, 111(22): 8392-8398 (25 Oct 1989).

KH is used to deprotonate ReH_7L_2 (L = PMe_2Ph, $PMePh_2$, and PPh_3) and ReH_5P_3 and WH_6P_3 (P = PMe_2Ph) in THF, and the resulting anions are characterized by variable-temperature multinuclear NMR. The solid-state structure of $K(THF)_2ReH_6(PPh_3)_2$ was determined by x-ray diffraction and revealed a centrosymmetric dimer connected by bridging hydrogen atoms. Crystallographic data (213 K): a = 10.987 (2), b = 27.134 (4), c = 14.030 (2) Å, β = 96.609 (13)°; V = 4154.6 (11) Å^3, and Z = 2 in space group $P2_1/n$.

42986 Thermochemical properties of gas-phase MgOH and MgO determined by fourier transform mass spectrometry. Operti, L. (Purdue Univ., West Lafayette, IN (USA)); Tews, E.C.; MacMahon, T.J.; Freiser, B.S. *Journal of the American Chemical Society (USA)*, 111(26): 9152-9156 (20 Dec 1989).

Gas-phase thermochemical values D^0 (Mg^+-OH) = 75 $\pm$ 4 kcal/mol. IP (MgOH) = 7.3 $\pm$ 0.1 eV, $D^0(Mg^+$-O) = 53 $\pm$ 3 kcal/mol and IP(MgO) = 7.9 $\pm$ 0.1 eV have been experimentally determined by photodissociation measurements and charge-transfer reactions with Fourier transform mass spectrometry. These results, together with previously determined thermochemical data, are used to determine other thermochemical properties of MgOH and MgO.

42987 Method for improving x-ray diffraction determinations of residual stress in nickel-base alloys. Berman, R.M.; Cohen, I. To Dept. of Energy, Washington, DC (USA). USA Patent 4918711/A/. 17 Apr 1990. Filed date 26 Apr 1988. USA Patent Application 7-186,422. Int. Cl. G01N 23/20. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a process for improving the technique for measuring residual stress by x-ray diffraction in pieces of nickel-base alloys. It comprises: covering part of a predetermined area of the surface of a nickel-base alloy with a dispersion, exposing the covered and uncovered portions of the surface of the alloy to x-rays by way of an x-ray diffractometry apparatus, making x-ray diffraction determinations of the exposed surface, and measuring the residual stress in the alloy based on these determinations. The dispersion is opaque to x-rays and serves a dual purpose since it masks off unsatisfactory signals such that only a small portion of the surface is measured, and it supplies an internal standard by providing diffractogram peaks comparable to the peaks of the nickel alloy so that the alloy peaks can be very accurately located regardless of any sources of error external to the sample.

3606 Other Materials

Refer also to citation(s) 42633, 42722, 42783, 42792, 42793, 42794, 42795, 42801, 42823, 42826, 42888, 42913, 42957, 43083, 43100, 43120, 43131, 43136, 43140, 43178, 43191, 43211, 43216, 43428

42988 (BNL–43723) **Electronic conduction in molten cryolite saturated with alumina.** Haarberg, G.M. (Trondheim Univ. (Norway). Labs. of Industrial Electrochemistry); Osen, K.S.; Thonstad, J.; Heus, R.J.; Egan, J.J. Brookhaven National Lab., Upton, NY (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-9005235–3: 7. international symposium on molten salts, Montreal (Canada), 6-11 May 1990). Order Number DE90015090. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Wagner polarization technique was used to study the electronic conduction in the melt $Na_3AlF_6 + Al_2O_3$ at 1000°C. Cells of the following type were employed TaC(s) | $Na_3AlF_6 + Al_2O_3$(sat.)(l) | Na – $Bi(l)_{x_{Na}=0.05}$ (I). Currents were measured at applied potentials lower than the those which would decompose the melt. In this way ionic currents are suppressed and only electronic currents flow. The electronic conductivity is determined from the current versus potential relation. Transient measurements taken on cell (I) yield the diffusion coefficient of electrons in the melt. 8 refs., 3 figs., 1 tab.

42989 (CEA-CONF–10180) **Conductivity of irradiated kapton in relation to energy loss of ions and electrons.** Costantini, J.M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (FR)); Flament, J.L.; Mori, V.; Sinopoli, L.; Trochon, J.; Uzureau, J.L.; Zuppiroli, L.; Forro, L.; Ardonceau, J.; Lesueur, D. CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France). 1989. 14p. (CONF-8906346–: 5. International Conference on Radiation Effects in Insulation, Hamilton (New Zealand), 19-23 Jun 1989). Order Number DE90511934. Source: NTIS (US Sales Only), PC A03/MF A01.

We have studied the effects of 2.5 MeV electron irradiation and ion (C, N, F, Si and Kr) bombardment on the electrical conductivity of a polyimide (Kapton-H) with ion energies ranging between 320 KeV (N) and 1.25 GeV (Kr). In this wide range of situations we have tried to sort out the respective effects of the nuclear and electronic excitation energy losses. For all ion irradiation the conductivity is found to scale with the electronic excitation absorbed dose: i. e. a power law of conductivity versus absorbed dose with an exponent around 9 is observed. At a given absorbed dose (in Gray units) the efficiency of each ion to enhance conductivity is found to be proportional to the electronic energy loss; electrons are much less efficient than ions and thus collective excitations are required to achieve this process. The nuclear energy loss can perhaps play some role at conductivities higher than $100\Omega^{-1}m^{-1}$ but its effects are negligible in the range explored here.

42990 (CERN–89-12.-Pt.1(ed.2)) **Compilation of radiation damage test data: Halogen-free cable-insulating materials.** Schoenbacher, H.; Tavlet, M. European Organization for Nuclear Research, Geneva (Switzerland). 31 Dec 1989. 223p. (In English, French). Order Number DE90635206. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

This report summarizes radiation damage test data on commercially available organic cable insulation and jacket materials: Ethylene-propylene rubbers, polyethylenes, polyurethanes, silicone rubbers, and copolymers based on polyethylene. The materials have been irradiated either in a nuclear reactor, or with a cobalt-60 source, or in the CERN accelerators, at different dose rates. The absorbed doses were between 10^3 and $5x10^6$ Gy. Mechanical properties, e.g. tensile strength, elongation at break, and hardness, have been tested on irradiated and non-irradiated samples, according to the recommendations of the International Electrotechnical Commission. The results are presented in the form of tables and graphs to show the effect of the absorbed dose on the measured properties. (orig.).

42991 (CONF-900513–2) **Friction microprobe studies of composite surfaces.** Blau, P.J. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by U.S. DOE Conservation &

Renewable Energy. DOE Contract AC05-84OR21400. From Conference on the tribology of composite materials; Oak Ridge, TN (USA); 1-3 May 1990. Order Number DE90014224. Source: NTIS, PC A02/MF A01 - OSTI.

A newly-constructed friction microprobe has been used to study the variations in friction force associated with unlubricated sliding of small 1.0 mm diameter. 440C stainless steel spheres over the surfaces of alumina, silicon nitride, silicon carbide, and silicon carbide whisker-reinforced composites with matrices of alumina and silicon nitride. The purpose of the work was to attempt to detect frictional transients associated with the sliding interaction of individual asperities and to relate these transients to the microstructures of the ceramics and their composites. Friction data could be obtained without detectable wear of either the spheres or the flat specimens. The presence of whiskers increased in the friction of alumina by about 28% and decreased the friction of silicon nitride by about 15%. Less than a 1% instantaneous variation in friction coefficient could be directly ascribed to contacts with whiskers. Future studies are planned to investigate whisker orientation effects on the variation of the sliding friction of composites. 11 refs., 8 figs., 3 tabs.

42992 (ILR-Mitt.-213(1988)) **Supporting strength of cylindrical pressure vessels in hybrid construction consisting of composite fibres and metal.** Voelzke, H.; Wiedemann, J. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt; Deutsche Forschungsgemeinschaft, Bonn (Germany, F.R.). 1988. 114p. (In German). Contract DFG Wi 32/35-1. Source: Available from Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

The aim of the investigations described in this report consists in developing, calculating and evaluating light high-pressure containers in hybrid constructions. Such 'partially reinforced vessels' in which fibre reinforcements are only applied in the cylindrical parts constitute a compromise between pure metal constructions with very heavy containers and fibre structures with a minimum weight. Their fields of application are seen in normal pressure cylinders and tanks and, in future, in solar hydrogen technology for the utilization of regenerative sources of energy. The test containers consist essentially of a cylindrical metal base (AlMgSi0,5) reinforced in a circumferential direction with a fibrous composite material (glassfibre reinforced plastic, asbestos fibre reinforced plastic, carbon fibre reinforced plastic), and closed at the sides with screwed flanges. The fibre reinforcement was applied with the winding method; the prepreg technique too, besides wet processing, has proved to be very useful. The internal pressure load was applied with hydraulic fluid through an electric driven pump, for reasons of safety. Strain measurements were performed exclusively with wire strain gauges which were connected to the change-over system of a measuring point and to a process computer. (orig./MM).

42993 (KIB-RUB-TWM-90-2) **A contribution to the physically and geometrically nonlinear computer analysis of general reinforced concrete shells.** Zahlten, W. Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenieurbau. Feb 1990. 245p. (In German, English). Source: Available from Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenieurbau.

Starting from a Kirchhoff-Love type shell theory of finite rotations a layered shell element for reinforced concrete is developed. The plastic-fracturing theory due to Bazant/Kim is used to describe the uncracked concrete. Tension cracking is controlled by a principle tensile stress criterion. An elasto-plastic law with kinematic hardening models the reinforcing steel. The tension stiffening concept of Gilbert/Warner allows an averaged consideration of the concrete between cracks. By discretization of the displacement field the element matrices are obtained which are derived via tensor notation. The nonlinear structural response is computed by incremental-iterative path-tracing algorithms. The range of applicability of the model is finally be proven by several examples with time-invariant and time-dependent loading. (orig.).

42994 (LA-UR-90-2362) **Evidence for a coherence gap in $Ce_3Bi_4Pt_3$.** Hundley, M.F. (Los Alamos National Lab., NM (USA)); Canfield, P.C.; Thompson, J.D. Fisk, Z.; Lawrence, J.M. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-900751-1: 6. international conference on valence fluctuations, Rio de Janeiro (Brazil), 9-13 Jul 1990). Order Number DE90014925. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In this paper we examine the physical properties of the f-electron system $Ce_3Bi_4Pt_3$. In the majority of cases f-moment compounds are metallic, and, depending upon the relative strength of competing magnetic interactions, have a superconducting, paramagnetic, or antiferromagnetic ground state. In rare instances f-electron compounds have a narrow-gapped insulating ground state instead. This gap is thought to result from hybridization between conduction and f electrons. We have measured the magnetic susceptibility, low-temperature specific heat, resistivity, Hall effect, and thermoelectric power of $Ce_3Bi_4Pt_3$ and find that this material is non-metallic at all temperatures. Isostructural lanthanum substitution for cerium suppresses the gap and produces transport and thermodynamic behavior that is characteristic of a relatively heavy Kondo impurity system. Further, the energy scale at which coherence develops is roughly equal to the energy gap in this compound. This suggests that the gap in $Ce_3Bi_4Pt_3$ appears to stem from the same requirements of lattice periodicity necessary for coherence to manifest itself in metallic systems. Hence, there is strong evidence that the insulating behavior displayed by $Ce_3Bi_4Pt_3$ results form the presence of a Kondo coherence-induced gap. 15 refs., 4 figs.

42995 (LA-UR-90-2363) **Antiferromagnetism and enhanced heat in CeM_2Sn_2 (M = Ni, Ir, Cu, Rh, Pd, and Pt).** Beyermann, W.P. (Los Alamos National Lab., NM (USA)); Hundley, M.F.; Canfield, P.C.; Fisk, Z.; Smith, J.L.; Thompson, J.D.; Godart, C.; Selsane, M. Los Alamos National Lab., NM (USA). [1990]. 13p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-900751-2: 6. international conference on valence fluctuations, Rio de Janeiro (Brazil), 9-13 Jul 1990). Order Number DE90014924. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Recently a new series of compounds has been discovered by M. Selsane et al. which has a structure close to $CeCu_2Si_2$. Specific heat, dc susceptibility, and resistivity measurements on annealed, polycrystalline samples of CeM_2 Sn_2 where M = Ni, Ir, Cu, Rh, Pd, or Pt indicate that each of these compounds orders antiferromagnetically with transition temperatures ranging from T_N = 4.1 K to ≈ 0.5 K. All these materials have significant enhancements of the specific heat just before the transition which can be as large as ~3.7 J/mole-K^2 in some cases. Provided the enhanced heat capacities above T_N are associated with large effective masses, the anomalously low ordering temperature and the very large C/T suggest that T_N and the Kondo temperature T_K are comparable, making these materials particularly attractive for studying the interplay between these competing interactions. In all cases except M = Ir, the susceptibility follows a Curie-Weiss behavior with a high temperature effective moment μ_{eff} ~2.54 μ_B/Ce, while the Ir compound has a very strong mixed-valent nature. 14 refs., 3 figs., 2 tabs.

42996 (LA-UR-90-2431) **Is there anything of practical value hidden amongst the composite toughening theories?: A Jim Mueller prospective.** Gac, F.D. Los Alamos National Lab., NM (USA). [1990]. 36p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-900160-4: 14. annual conference on composites and advanced ceramics, Cocoa Beach, FL (USA), 14-17 Jan 1990). Order Number DE90014905. Source: NTIS, PC A03/MF A01 - OSTI.

Numerous theories have been developed over the last three decades for explaining the toughening behavior of discontinuous fiber reinforced brittle matrix composites. The issue is the practical engineering utility of these theories. Upon compiling a table of fiber parameters that are identified in the predominant toughening mechanisms, a number of important features become evident for achieving high toughnesses. First, all of the mechanisms indicate that a high fiber volume fraction is desirable. Second, residual stresses appear to influence all of the composite toughening mechanisms. Third, the highest fiber tensile strength is preferred. Finally, fiber diameter and fiber-matrix interfacial shear strength are also important, but both are composite system and toughening mechanism specific. 25 refs., 13 figs., 1 tab.

42997 (LA-UR–90-2517) **Preparation of AlB_4C composites for image analysis.** Kelly, A.M.; Reiswig, R.D.; Hill, M.A.; Blumenthal, W.R. Los Alamos National Lab., NM (USA). [1990]. 27p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9007133–2: 23. international metallographic society annual convention, Cincinnati, OH (USA), 22-25 Jul 1990). Order Number DE90014694. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Composites made by infiltrating B_4C networks with aluminium, or its alloys are of interest for lightweight armor applications. Image analysis plays an important part in correlating the microstructures of such composites with their mechanical properties. Accurate image analysis requires a high degree of perfection in the metallographic preparation, which is particularly difficult where the phases present have such disparate hardness and reactivities. Two preparation procedures have been developed that produce adequate contrast and definition for analysis of key microstructural features. 8 refs., 5 figs., 1 tab.

42998 (N–90-20130) **Experimentally determined wear behavior of an Al_2O_3-SiC composite from 25 to 1200 C.** Dellacorte, C.; Farmer, S.C.; Book, P.O. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 22p. (NASA-TM–102549;E–5361;NAS–1.15:102549;CONF-900513–: Conference on the tribology of composite materials, Oak Ridge, TN (USA), 1-3 May 1990). Source: NTIS, PC A03/MF A01.

The sliding wear behavior of a self-mated alumina-silicon carbide whisker toughened composite was studied using optical, scanning electron (SEM) and transmission electron (TEM) microscopy. Because of its excellent strength and toughness properties this composite material is under consideration for use in heat engine applications for sliding contacts which operate at elevated temperatures. The composite's wear behavior and especially its wear mechanisms are not well understood. Pin-on-disk specimens were slid in air at 2.7 m/s sliding velocity, under a 26.5-N load, at temperatures 25 to 1200 C. Pin wear increased with increasing temperature. Based upon the microscopic analyses, the wear mechanism seems to be loosening of the reinforcing whiskers due to frictional and bulk heating. This leads to whisker pullout and increased wear.

42999 (N–90-21817) **Proceedings of the Advisory Committee on Standardization of Carbon-Phenolic Test Methods and Specifications.** Hall, W.B. Mississippi State Univ., Mississippi State, MS (USA). Apr 1990. 200p. (NASA-CR–186478;NAS–1.26:186478;CONF-8911214–: Standardization of carbon-phenolic test methods and specifications advisory committee meeting, Tempe, AZ (USA), 16 Nov 1989). Source: NTIS, PC A09/MF A02.

Topics addressed include: Polyacrylonitrile (PAN) activity; low fired PAN fiber program review; carbon fabric oxidation mass loss; gel permeation chromatography (GPC) test methodology; carbon assay testing; and NAR rayon yarn specifications.

43000 (N–90-21817, pp. 24) **Development of low thermal conductivity pan-based carbon fibers for solid rocket motor nozzle applications.** Clinton, R. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)); Pinoli, P.C. Mississippi State Univ., Mississippi State, MS (USA). Apr 1990. (NASA-CR–186478;NAS–1.26:186478;CONF-8911214–: Standardization of carbon-phenolic test methods and specifications advisory committee meeting, Tempe, AZ (USA), 16 Nov 1989). In *Proceedings of the Advisory Committee on Standardization of Carbon-Phenolic Test Methods and Specifications.* Source: NTIS, PC A09/MF A02.

The program plan for the development of low thermal conductivity PAN-based carbon fibers is presented and is separated into two phases. During the first phase, fiber trials are to be conducted by the participating carbonizers and two candidate fiber types are to be supplied by each. Fibers will be characterized and composite test articles constructed and tested in forty pound charge motor firings. From these results, the number of candidates will be reduced to five for further characterization in the second phase. In Phase 2, screening level mechanical and thermal properties will be generated. Carbon phenolic test articles will be fabricated using each of the selected fibers for performances testing in the MSFC Testbed's 2 inch throat solid rocket motor. Candidates will be ranked according to the results from those tests. The results will be compared to those generated on the PAN-based ablatives currently being evaluated under SPIP Subtask 3.2.1.3 to determine whether any candidates merit further evaluation. The influence of process temperature on critical properties of PAN-based carbon fibers is discussed and historical data is presented. The derived technical requirements for the development of low thermal conductivity PAN-based carbon fibers and the fiber characterization test methodologies are described.

43001 (N–90-21817, pp. 7) **Testing carbon fabric for oxidation mass loss.** Hall, W.B. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)); Fikes, L.A.; Pinoli, P.C. Mississippi State Univ., Mississippi State, MS (USA). Apr 1990. (NASA-CR–186478;NAS–1.26:186478;CONF-8911214–: Standardization of carbon-phenolic test methods and specifications advisory committee meeting, Tempe, AZ (USA), 16 Nov 1989). In *Proceedings of the Advisory Committee on Standardization of Carbon-Phenolic Test Methods and Specifications.* Source: NTIS, PC A09/MF A02.

Rayon based carbon fabric was studied to assess reactivity to air oxidation/gasification. Excessive laboratory variability of mass loss data by conventional thermal gravimetric analysis mandated a more fundamental approach to determine the sensitivity factors which influence the gasification process. Reaction activation energy and pre-exponential factor derived from the Arrhenius equation were used to assess the role of fabric firing temperature and Na catalytic action. Low temperature oxidation (400 to 500 C) was found to be most strongly influenced by Na catalytic action. At 400 C the oxidation rate was increased by 681 percent by 2,240 ppm Na. The presence of water soluble Na anion significantly reduced the reaction activation energy from 34 to 21 Kcal/mole. The effect of firing temperature shifted the pre-exponential factors progressively from 2.49 x 10(exp 6) to 2.63 x 10(exp 3) g/g-sec after 2,500 C heat treatment. The Arrhenius temperature dependency was also used to assess laboratory to laboratory variances. Reaction rate data generated at ICI Fiberite, Tempe, Arizona, and Lockheed Research was found to deviate by 13 C, when compared at 525 C isothermal temperature.

43002 (N–90-21824) **METCAN verification status.** Chamis, C.C.; Caruso, J.J.; Lee, H.J.; Murthy, P.L.N. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. May 1990. 16p. (NASA-TM–103119;E–5443;NAS–1.15:103119). Source: NTIS, PC A03/MF A01.

The status of the verification (comparisons of predictions with experimental data) of the METCAN (METal-matrix Composite ANalyzer) code at high temperature is summarized. Verification includes select available room temperature of W/Cu composites for different fiber volume ratios. It also includes high temperature properties for thermal expansion, moduli, strength and stress/strain behavior for SiC/Ti composites. Furthermore it includes limited cases for thermal fatigue strength degradation. The verification results summarized herein indicate that METCAN simulates complex high temperature metal matrix composite bahavior with reasonable accuracy and that it can be used with confidence to identify in-situ nonlinear behavior that influences composite properties.

43003 (N–90-21826) **Matrix density effects on the mechanical properties of SiC/RBSN composites.** Bhatt, R.T.; Kiser, J.D. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 17p. (NASA-TM–103098;E–5306;NAS–1.15:103098;AVSCOM-TR–90-C-008;CONF-9001 14. annual conference on composites and advanced ceramics, Cocoa Beach, FL (USA), 14-17 Jan 1990). Source: NTIS, PC A03/MF A01.

The room temperature mechanical properties were measured for SiC fiber reinforced reaction-bonded silicon nitride composites (SiC/RBSN) of different densities. The composites consisted of approx. 30 vol percent uniaxially aligned 142 micron diameter SiC fibers (Textron SCS-6) in a reaction-bonded Si3N4 matrix. The composite density was varied by changing the consolidation pressure during RBSN processing and by hot isostatically pressing the SiC/RBSN composites. Results indicate that as the consolidation pressure was increased from 27 to 138 MPa, the average pore size of the nitrided composites decreased from 0.04 to 0.02 microns and the composite density increased from 2.07 to 2.45 gm/cc. Nonetheless, these improvements resulted in only small increases in the first

matrix cracking stress, primary elastic modulus, and ultimate tensile strength values of the composites. In contrast, HIP consolidation of SiC/RBSN resulted in a fully dense material whose first matrix cracking stress and elastic modulus were approx. 15 and 50 percent higher, respectively, and ultimate tensile strength values were approx. 40 percent lower than those for unHIPed SiC/RBSN composites. The modulus behavior for all specimens can be explained by simple rule-of-mixture theory. Also, the loss in ultimate strength for the HIPed composites appears to be related to a degradation in fiber strength at the HIP temperature. However, the density effect on matrix fracture strength was much less than would be expected based on typical monolithic Si3N4 behavior, suggesting that composite theory is indeed operating. Possible practical implications of these observations are discussed.

43004 (N–90-22117) **Fatigue crack growth in unidirectional metal matrix composite.** Ghosn, L.J.; Telesman, J.; Kantzos, P. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 9p. (NASA-TM–103102;E–5426;NAS–1.15:103102;CONF-900764–: Fatigue '90 international conference, Honolulu, HI (USA), 15-20 Jul 1990). Source: NTIS, PC A02/MF A01.

The weight function method was used to determine the effective stress intensity factor and the crack opening profile for a fatigue tested composite which exhibited fiber bridging. The bridging mechanism was modeled using two approaches; the crack closure approach and the shear lag approach. The numerically determined stress intensity factor values from both methods were compared and correlated with the experimentally obtained crack growth rates for SiC/Ti-15-3 $(0)_8$ oriented composites. The near crack tip opening profile was also determined for both methods and compared with the experimentally obtained measurements.

43005 (N–90-22409) **JETC (Japanese Technology Evaluation Center) panel report on high temperature superconductivity in Japan.** Shelton, D.; Gamota, G. Loyola Coll., Baltimore, MD (USA). Nov 1989. 240p. (NASA-CR–180413;NAS–1.26:180413;PB–90-123126). Source: NTIS, PC A11/MF A02.

The Japanese regard success in R and D in high temperature superconductivity as an important national objective. The results of a detailed evaluation of the current state of Japanese high temperature superconductivity development are provided. The analysis was performed by a panel of technical experts drawn from U.S. industry and academia, and is based on reviews of the relevant literature and visits to Japanese government, academic and industrial laboratories. Detailed appraisals are presented on the following: Basic research; superconducting materials; large scale applications; processing of superconducting materials; superconducting electronics and thin films. In all cases, comparisons are made with the corresponding state-of-the-art in the United States.

43006 (N–90-22646) **Fatigue crack growth in a unidirectional SCS-6/Ti-15-3 composite.** Kantzos, P.; Telesman, J.; Ghosn, L. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 36p. (NASA-TM–103095;E–5413;NAS–1.15:103095;CONF-891115–: ASTM symposium on composite materials: fatigue and fracture, Orlando, FL (USA), 6-9 Nov 1989). Source: NTIS, PC A03/MF A01.

An investigation was conducted to characterize and model the fatigue crack growth (FCG) behavior of a SCS-6/Ti-15-3 metal matrix composite. Part of the study was conducted using a fatigue loading stage mounted inside a scanning electron microscope (SEM). This unique facility allowed high magnification viewing of the composite fatigue processes and measurement of the near crack tip displacements. The unidirectional composite was tested in the (0)8 (i.e., longitudinal) and (90)8 (i.e., transverse) orientations. For comparison purposes unreinforced matrix material produced by the identical process as the reinforced material was also tested. The results of the study reveal that the fatigue crack growth behavior of the composite is a function of specimen geometry, fiber orientation and the interaction of local stress fields with the highly anisotropic composite. In the case of (0)8 oriented single edge notch (SEN) specimens and (90)8 oriented compact tension (CT) specimens, the crack growth was normal to the loading direction. However, for the (0)8 CT specimens the crack grew mostly parallel to the loading and the fiber direction. The unusual fatigue behavior of the (0)8 CT specimens was attributed to the specimen geometry and the associated high tensile bending stresses perpendicular to the fiber direction. These stresses resulted in preferential cracking in the weak interface region perpendicular to the fiber direction. The interface region, and in particular the carbon coating surrounding the fiber proved to be the composites weakest link. In the (0)8 SEN the crack growth was confined to the matrix leaving behind unbroken fibers which bridged the cracked surfaces. As the crack grew longer, more fibers bridged the crack resulting in a progressive decrease in the crack growth rates and eventual crack arrest.

43007 (N–90-22651) **NASA-UVA light aerospace alloy and structures technology program.** Gangloff, R.P.; Haviland, J.K.; Herakovich, C.T.; Pilkey, W.D.; Pindera, M.; Stoner, G.E.; Swanson, R.E.; Thornton, E.A.; Wawner, F.E. Jr.; Wert, J.A. Virginia Univ., Charlottesville, VA (USA). Jun 1990. 400p. (NASA-CR–182607;NAS–1.26:182607;UVA–528266/MS90/106). Source: NTIS, PC A17/MF A03.

Progress Report, 1 Jan. - 30 Jun. 1990.

The objective of the Light Aerospace Alloy and Structures Technology Program is to conduct interdisciplinary graduate student research on the performance of next generation, light weight aerospace alloys, composites, and associated thermal gradient structures. Individual technical objectives are established for each project. Efforts aim to produce basic understanding of material behavior, monolithic and composite alloys, processing methods, solid and mechanics analyses, measurement advances, and a pool of educated graduate students. Progress is reported for 11 areas of study.

43008 (N–90-22767) **Development of a unique laboratory standard indium gallium arsenide detector for the 500 to 1700 micron spectral region, phase 2. Final report.** Ban, V.S.; Olsen, G.H. EPITAXX, Inc., Princeton, NJ (USA). May 1990. 50p. (NASA-CR–180482;NAS–1.26:180482). Source: NTIS, PC A03/MF A01; 1 functional color page.

Original contains color illustrations.

In the course of this work, 5 mm diameter InGaAs pin detectors were produced which met or exceeded all of the goals of the program. The best results achieved were: shunt resistance of over 300 K ohms; rise time of less than 300 ns; contact resistance of less than 20 ohms; quantum efficiency of over 50 percent in the 0.5 to 1.7 micron range; and devices were maintained and operated at 125 C without deterioration for over 100 hours. In order to achieve the goals of this program, several major technological advances were realized, among them: successful design, construction and operation of a hydride VPE reactor capable of growing epitaxial layers on 2 inch diameter InP substrates with a capacity of over 8 wafers per day; wafer processing was upgraded to handle 2 inch wafers; a double layer Si3N4/SiO2 antireflection coating which enhances response over the 0.5 to 1.7 micron range was developed; a method for anisotropic, precisely controlled CH4/H2 plasma etching for enhancement of response at short wavelengths was developed; and electronic and optical testing methods were developed to allow full characterization of detectors with size and spectral response characteristics. On the basis of the work and results achieved in this program, it is concluded that large size, high shunt resistance, high quantum efficiency InGaAs pin detectors are not only feasible but also manufacturable on industrial scale. This device spans a significant portion of visible and near infrared spectral range and it will allow a single detector to be used for the 0.5 to 1.7 micron spectral region, rather than the presently used silicon (for 0.5 to 1.1 microns) and germanium (0.8 to 1.7 microns).

43009 (N–90-22822) **High temperature fatigue behavior of a SiC/Ti-24Al-11Nb composite.** Bartolotta, P.A.; Brindley, P.K. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 15p. (NASA-TM–103157;E–5524;NAS–1.15:103157;CONF-900492–: 10. ASTM symposium on composite materials: testing and design, San Francisco, CA (USA), 24-25 Apr 1990). Source: NTIS, PC A03/MF A01.

A series of tension-tension strain- and load-controlled tests were conducted on unidirectional SiC/Ti-24Al-11Nb (at percent) composites at 425 and 815 C. Several regimes of damage were identified using Talrega's concept of fatigue life diagrams. Issues of test

technique, test control mode, and definition of failure were also addressed.

43010 (SAND–90-0146C) **Sol-gel film formation by dip coating.** Hurd, A.J.; Brinker, C.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900466–74: Spring meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Order Number DE90015167. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper, the physical aspects of sol-gel film formation are discussed. The equations governing the steady state film profile, controlled by hydrodynamic flow, capillary pressure and evaporation, are presented along with representative data obtained by imaging ellipsometry. Some issues concerning capillary collapse are also addressed.

43011 (SAND–90-0186C) **Use of electron spectroscopies in the tribological evaluation of diamond films.** Peebles, D.E.; Pope, L.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 54p. Sponsored by U.S. Department of Defense; U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Contract: FY 1457-89-5004. (CONF-9008127–1: International symposium on industrial tribology, Evanston, IL (USA), 29-31 Aug 1990). Order Number DE90014421. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Diamond films hold a lot of promise as tribological protective coatings, especially for applications in harsh environments. However, thorough examinations of the mechanisms of film failure and wear must be completed in order to optimize the tribological performance of diamond films. In situ electron spectroscopic analysis has been very successfully applied to such studies for metal-metal wear systems and for systems involving several types of dry film lubricants. This work describes our application of these types of studies to protective diamond films on silicon. We have characterized the diamond films by selected techniques, including: Raman spectroscopy, Auger electron spectroscopy, x-ray photoelectron spectroscopy, electron energy loss spectroscopy, and a specially developed charging probe technique. We have characterized the relative ability of each technique to discern film damage, while evaluating the conditions under which each technique may be used, including normal operations such as elastic peak optimization and sample imaging. Results are discussed for each technique which are representative of undamaged and damaged diamond bonding configurations. In addition, the effects of ion bombardment for cleaning and damaging the surface have been evaluated. Finally, applications of these techniques to studies of the tribology of 440C stainless steel pins on diamond films are discussed. These results show that in laboratory air, the observed friction coefficient is strongly correlated with the concentration of oxygen and the surface roughness in the wear track, with only a weak (if any) dependence on the type of carbon structure present (diamond versus graphite). 30 refs., 15 figs., 4 tabs.

43012 (SAND–90-0955C) **Radiation effects in InAsSb strained-layer superlattice photodiodes induced by dose-rate and transient x-ray environments.** Kurtz, S.R. (Sandia National Labs., Albuquerque, NM (USA)); Dawson, L.R.; Snyder, J.G. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900396–4: IRIS Specialty Group meeting on passive sensors and atmospheric physics, Laurel, MD (USA), 13 Mar 1990). Order Number DE90015000. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A side-by-side measurement was made of the gamma-flux noise in an InAsSb strained-layer superlattice (SLS) photodiode and a comparable HgCdTe photodiode. Correcting for minor differences in detector quantum efficiency and area, we found that the SLS can operate in a gamma-flux $\geq$ 10x that limiting HgCdTe detector performance. Transient photoresponse measurements on an InAsSb SLS detector were performed using a pulsed x-ray source. A detector recovery time of 150 nsec was observed, and modeling of the transient response predicted a minority carrier lifetime of 350 nsec and a diffusion length of 2 μm. 10 refs., 4 figs.

43013 (SAND–90-1582C) **Reflection mass spectrometry (REMS) during III/V MBE.** Tsao, J.Y.; Brennan, T.M.; Dawson, L.R.; Hammons, B.E.; Hibray, R.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9006246–1: BES material science program information and review meeting, Albuquerque, NM (USA), 20-21 Jun 1990). Order Number DE90014568. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Reflection Mass Spectrometry (REMS) consists of a cryo-shrouded mass spectrometer which measures mass-analyzed, line-of-sight chemical fluxes from a growing wafer. It is especially useful during III/V molecular beam epitaxy (MBE) for which there are always substantial group V fluxes and often some group III fluxes leaving the wafer during growth. These fluxes depend sensitively on the instantaneous chemical reactivity of the surface. That chemical reactivity in turn depends on instantaneous alloy composition (III/III ratio), surface stoichiometry (As coverage) and temperature. In this brief summary of our work, we describe two examples of the "engineering" usefulness of REMS, involving MBE of InAlAs and InGaAs and one example of measurements of basic scientific interest. 3 figs.

43014 (SERI/TP–211-3805) **Research on stable, large-area, amorphous silicon based submodules: Phase 3, Semi-annual subcontract report, February 1, 1989–July 31, 1989.** Catalano, A. (Solarex Corp., Newtown, PA (USA). Thin Film Div.); Arya, R.R.; Bennett, M.; Fieselmann, B.; Goldstein, B.; Morris, J.; Newton, J.; O'Dowd, J.; Oswald, R.S.; Podlesny, R.; Wiedeman, S.; Yang, L. Solar Energy Research Inst., Golden, CO (USA); Solarex Corp., Newtown, PA (USA). Thin Film Div. Jul 1990. 98p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000339. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This research program encompasses materials research, non-semiconductor materials research, and submodule research. Researchers studied the materials' considerations that limit transport in the a-SiGe:H alloys, and developed alloys with improved properties. These studies indicated that the homogeneity of the alloy plays an important role in determining electronic properties. P-type a-SiC:H films were also prepared using trimethylboron as a dopant. The conductivity of the films was about an order of magnitude better than the comparable bandgap diborane-doped film. This allowed devices with improved voltage (0.943 V) to be demonstrated. Scientists also investigated the optimum device structures for the bottom, a-SiGe:H cell. This study concluded that grading the i-regions is an important element in obtaining the best performance, but the results differ significantly from those reported elsewhere. The results of this study have been incorporated in a number of tandem and triple-junction devices that have resulted in efficiencies in the range of 10–11%. A laser-scribing process for the highly reflecting ITO/Ag rear contact has enabled the cell results to be transferred to prototype modules with conversion efficiencies between 9% and 10%. 23 refs., 51 figs., 8 tabs.

43015 (UCRL–94406) **Gels from rigid rod polymer isocyanate systems.** Lucht, L.M. (Lawrence Livermore National Lab., CA (USA)); Shell, P.K.; Cook, R.C.; Cook, A.R.; Green, M.M.; Gross, R.A.; Reidy, M. Lawrence Livermore National Lab., CA (USA). May 1986. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-860911–34: 192. American Chemical Society national meeting, Anaheim, CA (USA), 7-12 Sep 1986). Order Number DE90015367. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The rigid rod character of polyisocyanates and polyisonitriles is due primarily to steric forces. This permits alternation of the functionality of the pendant groups and allows the polymer to be engineered to specific applications, such as organic conductors or optically active films. Since under the proper conditions these polymers form gels, they may also be useful as controlled release gels or low density foams. So far, we have shown that crosslinked gels and foams can be made. Details of synthesis and characterization of both crosslinked and uncrosslinked isocyanate gels with a hexyl pendant group and gels with a dodecyl pendant group will be discussed. 14 refs., 1 fig.

43016 Inherently conducting polymers. Aldissi, M. (Los Alamos National Lab., NM (USA)). 96p. Noyes Publications, Park Ridge, NJ (USA) (1989).

Electrically conducting polymers have many potential commercial applications and are thus a focus of research interest. Such polymers depend on a conjugated backbone that can be doped with highly reactive materials to increase conductivity. Topics covered in this book include: Synthesis of conjugated polymers, Electronic structure in conjugated polymers, Doping of conjugated polymers-conducting polymers, and Transport properties - semiconductor to metal transition.

43017 X-ray diffraction for nondestructive characterization of polycrystalline materials. Ruud, C.O. (Pennsylvania State Univ., 159 Materials Research Lab., University Park, PA (US)); Weedman, S.D. pp. 71-76 of Nondestructive monitoring of materials properties: Volume 142. Holbrook, J.; Bussiere, J. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-881155–: Fall meeting of the Materials Research Society, Boston, MA (USA), 28 Nov - 3 dec 1988).

X-ray diffraction has long been the mainstay for materials characterization in the laboratory. This characterization includes the determination of phase composition, residual stress, microstrain, grain size, and crystallographic texture of polycrystalline metals, ceramics, and minerals. The analytical capabilities of XRD techniques have been expanded recently by the application of computer control to data collection and processing. These capabilities include the identification of irregularities in metals and ceramics that are caused by processing and fatigue damage, as well as the apriori prediction of processing anomolies. The availability of computer-controlled position-sensitive x-ray detectors can now provide rapid, non-contacting, in-process interrogation of materials. The examples of nondestructive characterization illustrated in this paper are those that can be used for process control and/or damage assessment.

43018 Strain hardening in salt: Results of the Salmon experiment. Glenn, L.A. (Shock Physics Program, ESD, Lawrence Livermore National Lab., Livermore, CA (US)). pp. 151-156 of Proceedings of the offshore and arctic operations symposium 1990: Volume 2. Urquhart, R.G.; Ertas, A.; Hui, D. American Society of Mechanical Engineers, New York, NY (USA) (1990). DOE Contract W-7405-ENG-48. (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

Salmon was a nuclear explosion in the Tatum salt dome, near Hattiesburg, Mississippi, that took place on October 22, 1964. Computational attempts to simulate the experimental results had been largely unsuccessful. Recent calculations suggest that the reason is that the salt yield strength is extremely sensitive to strain hardening. The hardening effect had not been observed in laboratory-scale measurements, which were not made at small enough strain levels and may not have been representative of in situ pore-fluid pressure.

43019 Optimization of a TiN/$TiSi_2$ p+ diffusion barrier process. Leem, S.S. (NCR Corp., Colorado Springs, CO (US)); Galovich, C.S.; Fuchs, K.P.; Kwong, D.L.; Hirvonen, J.; Huang, J. pp. 217-222 of Rapid thermal annealing/chemical vapor deposition and integrated processing. Hodul, D.; Gelpey, J.C.; Green, M.L.; Seidel, T.E. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

The TiN/$TiSi_2$ structure, formed by rapid thermal nitridation of a sputter-deposited titanium film, has been demonstrated to be effective as a diffusion barrier and as a low resistance contact material for VLSI submicron metallization. An optimization experiment, designed using the RS/Discover software package, was used to identify a metallization process that minimized p + resistance as well as maximized barrier capability. Source/drain implant doses, as-deposited titanium film thickness, and rapid thermal processing parameters were the factors varied in the experiment. Of particular significance is a comparison of the effects of a two-step versus one-step rapid thermal anneal on control of the TiN/$TiSi_2$ thickness ratio. A TiN layer of sufficient thickness for barrier integrity and adequate consumption of implant damage in the formation of the $TiSi_2$ layer are desired. Electrical and thermal stability measurements of the resultant AlSiCu/TiN/$TiSi_2$ p + contact system are presented.

43020 Influence of post-deposition treatment by UV light and oxygen (ozone) on 350 nm damage thresholds of SiO_2 films deposited from sols. Thomas, I. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Wilder, J.; Lee, A.; George, D. pp. 297-299 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). DOE Contract W-7405-ENG-48. (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Certain multilayer porous silica AR coatings on fused silica substrates prepared by the sol-gel process have been found to have a much lower laser damage threshold than single layer coatings prepared by the same method. Treatment with UV light in the presence of oxygen (which gives ozone) at low temperature was found to restore damage thresholds to the levels found in single layers. Damage thresholds were measured at 350 nm with a 25 ns pulse for 1000 shots at 25 Hz. The effect of exposure time and other factors such as replacement of oxygen with nitrogen and vacuum are described.

43021 Improvement of minority-carrier properties of GaAs on Si. Vernon, S.M. (Spire Corp., Bedford, MA (USA)); Dixon, T.M.; Tobin, S.P.; Karam, N.H.; Ahrenkiel, R.K.; Al-Jassim, M.M.; Jones, K.M. pp. 349-356 of III-V heterostructures for electronic/photonic devices: Volume 145. Tu, C.W.; Mattera, W.D.; Gossard, A.C. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

GaAs-on-Si structures have been grown by atmospheric-pressure metalorganic chemical vapor deposition (MOCVD); in some samples, the GaAs nucleation layer was deposited by atomic layer epitaxy (ALE). Material quality has been characterized by Nomarski microscopy, time-resolved photoluminescence, transmission electron microscopy, and the performance of photovoltaic devices. The minority-carrier lifetime has been correlated with defect density and growth parameters. The use of a thermal-cycle-growth technique is seen to be a major factor in improving GaAs-on-Si material quality without resorting to the use of thick buffer layers.

43022 Fluorinated monomolecular assemblies: Model systems to probe chemical interactions at the polymer-metal interface. Chau, L.K. (Dept. of Chemistry and Ames Lab., USDOE, Iowa State Univ., Ames, IA (US)); Porter, M.D. pp. 311-316 of Electronic packaging materials science IV: Volume 154. Jaccodine, R.; Jackson, K.A.; Lillie, E.D.; Sundahl, R.C. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract W-7405-ENG-82. (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Monomolecular assemblies of n- perfluorocarboxylic acids [$CF_3(CF_2)_nCOOH$, n = 6, 7, and 8] have been adsorbed at silver by spontaneous adsorption from dilute alcoholic solutions. Infrared reflection spectroscopy indicates that the monolayers form by the reactive chemisorption of the carboxylic acid to a carboxylate salt. Ellipsometrically-determined film thicknesses increase linearly with an increase in the perfluorocarbon chain length. Contact angle measurements indicate that the packing density of the films increases with increasing chain length, resulting in an interface with a low surface free energy. The structure and properties of these interfaces are compared to those for monolayers of n-alkanoic acids. The potential utility of such assemblies to probe fundamental chemical and physical interactions at polymer- metal interfaces are also discussed.

43023 Photoelectronic properties of low temperature GaAs grown on silicon and GaAs substrates by MBE. Mariella, R.P. (Lawrence Livermore National Lab., CA (USA)); Morse, J.D.; Aines, R.; Hunt, C.E. pp. 325-330 of III-V heterostructures for electronic/photonic devices: Volume 145. Tu, C.W.; Mattera, W.D.; Gossard, A.C. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract W-7405-ENG-48. (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

The characteristics of GaAs layers grown by MBE at growth temperatures from 200°C to 400°C have been evaluated by photoconductivity experiments in order to understand the photoelectronic properties of this material. Low temperature (LT) growth of GaAs on both silicon and GaAs substrates has been investigated in an attempt to better understand the nature of defects which are created in epitaxial layers grown under these conditions. Results from experiments on both annealed and unannealed LT samples indicate that the electronic transport properties of the epilayers can be controlled by selecting the appropriate growth conditions.

43024 Initial nucleation studies of heteroepitaxial GaAs films on Si substrates by modulated beam epitaxy. Lee, H.P. (California Univ., Berkeley, CA (USA). Dept. of Electrical Engineering and Computer Sciences); Liu, X.; Wang, S.; George, T.; Weber, E.R.; Liliental-Weber, Z. pp. 357-366 of III-V heterostructures for electronic/photonic devices: Volume 145. Tu, C.W.; Mattera, W.D.; Gossard, A.C. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426--: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Nominal 100 Å and 150 Å thick GaAs layers were deposited on Si substrates by a modulated molecular beam technique and normal molecular beam epitaxy (MBE) at 300°C and 375°C respectively for plan view and cross-sectional transmission electron microscopy (TEM) examinations. From coverage of Moire fringes, it is found that the nucleated GaAs films grown by the modulated molecular beam technique were thinner, streaker and more two-dimensional than the MBE grown films. The same modulated molecular beam technique was also used for the deposition of the initial buffer layer of 3μm thick GaAs on Si films. Results from the 77k photoluminescence (PL) and double crystal X ray diffraction measurements show that these films have superior optical and structural quality compared to similar films grown by normal two-step MBE. The improvement is attributed to a more two-dimensional nucleation of GaAs films associated with the modulated molecular beam growth technique.

43025 Influence of substrate on cracking of vapor-deposited thin films due to residual stresses. Fisher, R.M. (Center for Advanced Materials and Chemical Sciences Div., Lawrence Berkeley Lab, Berkeley, CA (US)); Duan, J.Z. pp. 343-348 of Electronic packaging materials science IV: Volume 154. Jaccodine, R.; Jackson, K.A.; Lillie, E.D.; Sundahl, R.C. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract AC03-76SF00098. (CONF-8904262--: 2. national symposium on paraseismic engineering, Saint-Remy-les-Chevreuse (France), 18-20 Apr 1989).

The influence of the substrate material on the column and grain microstructure, the residual stresses, crack patterns and delamination of Cr films has been investigated using TEM, SEM, and X-ray diffraction. The inter-influence of these factors which determine the long term reliability of microelectronics is discussed. When interfacial adhesion is very low, as may be the case with some polymer substrates, cracking occurs discontinuously during film formation each time the stress exceeds the critical value for fracture.

43026 Kinetic model for metal-organic chemical vapor deposition of GaAs with organometallic-arsenic precursors. Omstead, T.R. (Univ. of Minnesota, Minneapolis (USA)); Jensen, K.F. *Journal of Physical Chemistry (USA),* 2(1): 39-49 (Jan-Feb 1990).

Models for the chemical kinetics of the growth of GaAs by using triethylgallium and trimethylgallium with trimethylarsene, triethylarsene, tert-butylarsine, and phenylarsine are described. Emphasis is placed on results obtained with a metal-organic chemical vapor deposition reactor equipped with a recording microbalance for in situ growth rate measurements. Rate data show that the growth with these precursors is dominated by adduct-related parasitic gas-phase reactions at high temperatures and by surface reactions at lower temperatures. A model is proposed for the competition between deposition reactions and the parasitic gas-phase reactions. The kinetic model works well for all combinations of precursors except for triethylgallium and trimethylarsene, where extensive gallium droplet formation is observed at low temperatures. The predicted rate constants reflect the trends expected from the chemical structure of the arsenic precursors and their tendency to form adduct compounds. In addition to the chemical investigations, the electrical properties of GaAs grown with triethylgallium and tert-butylarsine are examined by using the Hall effect. This source combination, which has not been used previously, gives promising results for the growth of GaAs.

43027 Structural and magnetic characterization of α- and β-4,4′-(butadiyne-1,4-diyl)bis(2,2,6,6-tetramethyl-4-hydroxypiperidin-1-oxyl) and characterization of its thermal degradation product. Miller, J.S. (E.I. du Pont de Nemours and Co., Inc., Wilmington, DE (USA)); Calabrese, J.C.; Laversanne, R.; Epstein, A.J.; Chittipeddi, S.; Vaca, P.; Brill, T.B.; Timken, M.D.; O'Connor, C.J.; Zhang, J.H.; Glatzhofer, D.T. *Journal of Physical Chemistry (USA),* 2(1): 60-69 (Jan-Feb 1990).

A new polymorph of 4,4′-(butadiyne-1,4-diyl)bis(2,2,6,6-tetramethyl-4-hydroxypiperidine-1-oxyl), 1, has been prepared. Both phases have been characterized by x-ray diffraction, infrared and Raman spectroscopies, and magnetic susceptibility. The α-phase belongs to the Pccn space group [a = 19.049 (4) Å, b = 16.107 (4) Å, and c = 14.113 (3) Å, V = 4330 (3) Å^3, Z = 8, T = -115°C, R_u = 7.0%, R_w = 8.0%] and the β-phase belongs to the $Pca2_1$ space group [a = 14.265 (1) Å, b = 8.079 (3) Å, and c = 18.865 (2) Å, V = 2174.1 Å^3, Z = 4, T = -100°C, R_u = 4.8%, R_w = 5.0%]. The molecular structures of both phases are essentially equivalent with the average C≡, CC-CC, and NO distances of 1.200, 1.385, and 1.288 Å, respectively. The hydrogen bonding OH···ON (or O···O) interactions [i.e., 1.70 (2.834) and 1.72 Å (2.757 Å) for the α-phase and 1.85 (2.804) and 1.84 Å (2.788 Å) for the β-phase] are the only significant intermolecular interactions. Intense ν_{NO} and $\nu_{C\equiv C}$ (Raman) vibrations occur at 1341 and 2236 cm^{-1}, respectively, for both phases. A pleated sheet and helical, hydrogen-bonded solid-state motifs are observed for the α- and β-phases, respectively. On the basis of accepted structural criteria, both solid-state structures should not support single-crystal topochemical polymerization and UV, electron beam, and γ-ray induced polymerization has not been achieved for either phase. Thermal treatment, however, turns the crystals black.

43028 Synthesis and characterization of III-V semiconductor clusters: GaP in zeolite Y. MacDougall, J.E. (Univ. of California, Santa Barbara (USA)); Eckert, H.; Stucky, G.D.; Herron, N.; Wang, Y.; Moller, K.; Bein, T.; Cox, D. *Journal of the American Chemical Society (USA),* 111(20): 8006-8007 (27 Nov 1989).

Size quantization effects observed in small semiconductor clusters are currently of great interest for potential nonlinear optic and photocatalytic applications. While materials based on II-VI semiconductors have been extensively studied, the preparation of III-V size quantized semiconductors has been hampered by the much less-developed solution state chemistry in such systems. With the use of inclusion chemistry, we have succeeded in preparing small clusters of GaP in a crystalline, periodic environment of well-defined size and shape (zeolite Y).

43029 Elastomer degradation sensor using a piezoelectric material. Olness, D.U.; Hirschfeld, T.B. To Dept. of Energy, Washington, DC (USA). USA Patent 4906917/A/. 6 Mar 1990. Filed date 1 Jun 1989. USA Patent Application 7-359,463. Int. Cl. G01R 31/00. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method and apparatus for monitoring the degradation of elastomeric materials. Piezoelectric oscillators are placed in contact with the elastomeric material so that a forced harmonic oscillator with damping is formed. The piezoelectric material is connected to an oscillator circuit. A parameter such as the resonant frequency, amplitude or Q value of the oscillating system is related to the elasticity of the elastomeric material. Degradation of the elastomeric material causes changes in its elasticity which, in turn, causes the resonant frequency, amplitude or Q of the oscillator to change. These changes are monitored with a peak height monitor, frequency counter, Q-meter, spectrum analyzer, or other measurement circuit. Elasticity of elastomers can be monitored in situ, using miniaturized sensors.

40 CHEMISTRY

4001 Analytical and Separations Chemistry

Refer also to citation(s) 42339, 42386, 42387, 42840, 42911, 42912, 42964, 43013, 43022, 43025, 43044, 43312, 43515, 43568

43030 (BARC–1466) **Determination of trace level rare earth elements in nuclear grade uranium by X-ray excited optical luminescence method.** Agrawal, R.M. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.); Kamat, M.J.; Kaimal, R.; Malhotra, S.K. Bhabha Atomic Research Centre, Bombay (India). 1989. 15p. Order Number DE90635143. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A modified method for the direct determination of trace level rare earth elements Gd, Sm, Eu, Dy and Pr in nuclear grade uranium oxide employing X-ray excited optical luminescence (XEOL) is described. This method employs a quaternary oxide host system $2Li_2O.SrO.UO_2.2WO_3$ which supports the XEOL of rare earth ions. The powdered host is pressed in a planchet, exposed to X-rays and the optical luminescence produced is recorded. The range of concentrations for which the working curves are established is 0.04-1 ppm for Gd and Pr and 0.1-2 ppm for Sm, Dy and Eu. Er added at 10 ppm level in the host serves as internal standard. The effect of prolonged X-ray irradiation of the luminophor on the XEOL intensities of rare earth ions is studied and its results are also presented. (author). 8 refs., 7 tabs., 1 fig.

43031 (CBPF-NF–070/88) **Muon induced fission and fission track dating of minerals.** Marques, A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 16p. Order Number DE90635108. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The effects of muon induced fission on geological dating of samples by the fission track method are evaluated for the case of muscovite minerals. It is found a small but significant effect, greater for the longer ages. Since calculations are developped under the hypothesis of constant atmosphere and primary cosmic ray flux it is suggested that any discrepancy found in ages of very old material that cannot be accounted for by well known environmental influences, be taken as an indication of variation on either the atmospheric stopping power or the intensity of cosmic radiation along the ages. (author).

43032 (CEA-CONF–10031) **In-line and real time assay of uranium, plutonium and other heavy elements in process solutions.** Gontier, J.; Guiberteau, P.; Pelletier, T.; Bergey, C. CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France). 1989. 7p. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). Order Number DE90511936. Source: NTIS (US Sales Only), PC A02/MF A01.

We propose a new technique based on in-line and real time determination performed on the totality of the solution. Instrumentation is based on three sensors disposed on the pipe in which the process solution is flowing: - K - X and γ rays energy dispersive spectrometer - magnetic flowmeter - H^+ selective electrode sensor. The combination of informations given by the three sensors allows the instantaneous calculation of the transferred masses of U, Pu, AM... flowing the pipe. The technique is tested on solutions free of fission products.

43033 (INP–1343/PS, pp. 9-50) **Material analysis using energetic ion induced X-ray emission: PIXE and HEHIXE.** Heitz, Ch. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1986. (CONF-8604259–: 21. winter school of physics, Zakopane (Poland), 7-11 Apr 1986). In *Proceedings of 21. winter school on physics, Zakopane, Poland, 14-20 April, 1986. Part 2: Part 2. Condensed matter studies by nuclear methods.* Order Number DE90634553. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

The principles of the emission of characteristic X-rays by elements present in the target when it is bombarded with an energetic ion beam are described. The technical aspects of PIXE (proton induced X-ray emission) and HEHIXE (high energy heavy ion induced X-ray emission) analysis, are also presented. The uses of these methods to the analysis of clay, coating and paint of an Aztec ceramic samples are described. 52 refs., 16 figs., 2 tabs. (author).

43034 (INP–1343/PS, pp. 51-79) **Low-Z element analysis by nuclear reactions.** Bauer, C. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Rudolph, W.; Heiser, C.; Grambole, D.; Herrmann, F. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1986. (CONF-8604259–: 21. winter school of physics, Zakopane (Poland), 7-11 Apr 1986). In *Proceedings of 21. winter school on physics, Zakopane, Poland, 14-20 April, 1986. Part 2: Part 2. Condensed matter studies by nuclear methods.* Order Number DE90634553. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

The analytical capabilities of nuclear reactions for low-Z element diagnostics were demonstrated on a selection of examples to illustrate the employment of both yield curves in the vinicity of narrow resonances as well as radiation spectra measured at fixed ion energy. Nuclear reactions have been represented as a valuable extension of other analytical techniques like Auger-spectroscopy and SIMS. 22 refs., 14 figs., 5 tabs. (author).

43035 (Juel–2300) **Effects of inorganic sample constituents on atomic absorption spectroscopy in lead. Reaction mechanisms in the graphite tube atomizer and their effects on the analytical signal.** Novak, L. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie; Bonn Univ. (Germany, F.R.). Aug 1989. 183p. (In German). Order Number DE90510283. Source: NTIS (US Sales Only), PC A09/MF A01.

Graphite tube atomic absorption spectrometry (GFAAS) with electrothermal atomization enables trace element analyses down to the μg/kg range; however, the specific analytic signal is found to be disturbed by the matrix composition. The report determines and analyzes these matrix effects; disturbances in the gaseous phase are distinguished from those of the solid and liquid phase. The temperature curve during pretreatment and atomization is determined by accurate measurements. Brown algae were used on the experiment as a typical example of a problematic sample matrix. The negative effect of disturbances on the Pb measuring signal is found to be caused by inorganic substances. Various matrix modifiers are investigated as a means of reducing interferences, and the method of analysis is optimized for lead analysis in brown algae, urine, and rat bones. (RB).

43036 (KFK–4684) **Mass spectrometry of secondary neutrals and ions for the chemical analysis of salts.** Fichtner, M.; Lipp, M.; Goschnick, J.; Ache, H.J. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Schadstoffbeherrschung in der Umwelt (PSU). Mar 1990. 40p. (In German). Order Number DE90510179. Source: NTIS (US Sales Only), PC A03/MF A01.

Complete characterization of solid environmental samples requires a very sensitive chemical analysis, which includes the detection of elements, their compounds and their spatial distribution. For other applications the mass spectrometry of neutral and ionic secondary particles has been found to be a very sensitive tool, which can achieve a depth resolution of only a few atomic layers. As salts are frequent components of environmental material (e.g. aerosol deposits) model samples like chlorides, carbonates, nitrates and sulfates were chosen to investigate the kind of information available from ion impact mass spectrometry under dynamic conditions. An electron cyclotron wave resonance plasma was used as ion source and for the ionization of sputtered neutrals. This first investigation on the application of plasma based SNMS to salt samples revealed, that quantitative analysis for all elements is possible with only a moderate matrix dependence due to the high amount of sputtered neutral atoms. The far smaller contribution of neutral binary clusters enables SNMS to give compound specific information in some cases. But SIMS is shown to be more appropriate for the characterization of compounds or complex anions. Although substantial material removal rates by ion bombardment

induce inevitably chemical reactions the presented results demonstrate, that in most cases a chemical speciative analysis of salt containing samples can be done by SNMS and SIMS. (orig.).

43037 (LA-UR–90-2355) **Some target assay uncertainties for passive neutron coincidence counting.** Ensslin, N.; Langner, D.G.; Menlove, H.O.; Miller, M.C.; Russo, P.A. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–44: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014928. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper provides some target assay uncertainties for passive neutron coincidence counting of plutonium metal, oxide, mixed oxide, and scrap and waste. The target values are based in part on past user experience and in part on the estimated results from new coincidence counting techniques that are under development. The paper summarizes assay error sources and the new coincidence techniques, and recommends the technique that is likely to yield the lowest assay uncertainty for a given material type. These target assay uncertainties are intended to be useful for NDA instrument selection and assay variance propagation studies for both new and existing facilities. 14 refs., 3 tabs.

43038 (MLM–3639) **Tracer studies for determining dispersion coefficients in isotope exchange columns.** Junker, D.M. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 16 Jul 1990. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. Order Number DE90014735. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Tracer studies were run in ion exchange columns to determine dispersion coefficients. These coefficients are applicable to N^{15}–N^{14} isotope separation by displacement band chromatography. In conjunction with a model that describes the mass conservation of such a system, the feasibility of this separation method can be estimated. The traces were run at superficial velocities between 0.0487 and 0.2436 cm/s in three columns with diameters of 0.66, 1.0, and 2.54 cm. Dispersion coefficients were obtained in the range of 0.00319 to 0.0302 cm^2/s. These coefficients were extracted by the method of moments from traces of a nonabsorbing but porous matrix. Dispersion increased as flow rate and column diameter increased, although dependence on column diameter was not strong. 15 refs., 11 figs., 3 tabs.

43039 (STEV-FGT–90-2, pp. 2:1-11) **Thermogravimetric investigation of biomass char.** Statens Energiverk, Stockholm (Sweden). Nov 1989. (In Swedish). Project STEV-136-026. In *Biogasification LTH. Final report, step 7.* Order Number DE90512648. Source: NTIS (US Sales Only), PC A05/MF A01.

To estimate gas production in a gasification reactor, kinetics of pyrolysis reactions are needed. Also gasification reactions of char with water vapor in particular but also with carbon dioxide have to be considered. This study describes gasification of biomass char in water vapor and in carbon dioxide atmospheres. One method to study char gasification is thermogravimetric analysis. The report presents kinetic data of biomass char gasification with steam at various partial pressures of the reactive gas. As steam gasification is of greater technological interest plus the fact that the reaction rate is 20-30 times faster, the interest was focused on water vapor gasification. In addition some experiments of carbon dioxide gasification were made at higher pressures in pure carbon dioxide atmosphere. Wood char was investigated at four water vapor partial pressures and at three different pressures by pure carbon dioxide gasification. The experiment was done at total pressures between 0.33 and 10.0 bar. The temperatutes were 800, 850 and 1000 deg C. The reaction rate of water vapor gasification was 20-40 times higher than that of carbon dioxide. Kinetic parameters for the processes were estimated. (O.S.) (12 figs.).

43040 Highly-efficient fluorination of plutonium oxide to plutonium hexafluoride with photolytically-produced oxygen fluorides. Lyman, J.L. (Los Alamos National Lab., NM (USA)); Holland, R.; Loge, G.W. pp. 68-69 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors have measured the efficiency of fluorination of PuO_2 by photolytically-produced active fluorine (F, O_2F, O_2F_2). The active fluorine species are produced by uv laser photolysis of F_2 in the presence of oxygen. Subsequent chemical reactions in the gas phase convert the atomic fluorine to O_2F or O_2F, and eventually back to F_2. The active fluorine species are produced near the oxides and have some probability of reacting to form PuF_6, which is monitored spectroscopically. They have successfully determined conditions for conversion of PuO_2 to PuF_6 with near perfect efficiency.

43041 Comparison of photoacoustic spectroscopy, conventional absorption spectroscopy, and potentiometry as probes of lanthanide speciation. Torres, R.A. (Lawrence Livermore National Lab., CA (USA)); Palmer, C.E.A.; Baisden, P.A.; Russo, R.E.; Silva, R.J. *Analytical Chemistry (Washington) (USA),* 62(3): 298-303 (1 Feb 1990). DOE Contract W-7405-ENG-48.

The authors measured the stability constants of praseodymium acetate and oxydiacetate complexes by laser-induced photoacoustic spectroscopy, conventional UV-visible absorption spectroscopy, and pH titration. For the spectroscopic studies, changes in the free Pr absorption peaks at 468 and 481 nm were monitored at varying ligand concentrations. The total Pr concentration was 1×10^{-4} M in solutions used for the photoacoustic studies and 0.02 M for conventional spectroscopy. For the pH titrations, we used solutions whose Pr concentrations varied from 5×10^{-3} to 5×10^{-2} M, with total ligand-to-metal ratios ranging from 1 to 10. A comparison of the results obtained by the three techniques demonstrates that photoacoustic spectroscopy can give the same information about metal-ligand speciation as more conventional methods. It is particularly suited to those situations where the other techniques are insensitive because of limited metal concentrations.

43042 Solvent composition and process for the isolation of radium. McDowell, W.J.; Case, G.N. To Dept. of Energy, Washington, DC (USA). USA Patent 4917825/A/. 17 Apr 1990. Filed date 5 Oct 1988. USA Patent Application 7-253,634. Int. Cl. G21F 7/08. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a solvent extraction composition for radium. It comprises: a high molecular weigh organophilic carboxylic acid and an organophilic macrocycle dissolved in a suitable solvent.

43043 Permeation absorption sampler with multiple detection. Zaromb, S. To Dept. of Energy, Washington, DC. USA Patent 4912051/A/. 27 Mar 1990. Filed date 30 Mar 1989. USA Patent Application 7-330,654. Int. Cl. G01N 1/18. 12p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a system for detecting analytes in air or aqueous systems which includes a permeation absorption preconcentrator sampler for the analytes and analyte detectors. The preconcentrator has an inner fluid-permeable container into which a charge of analyte-sorbing liquid is intermittently injected, and a fluid-impermeable outer container. The sample is passed through the outer container and around the inner container for trapping and preconcentrating the analyte in the sorbing liquid. The analyte can be detected photometrically by injecting with the sorbing material a reagent which reacts with the analyte to produce a characteristic color or fluorescence which is detected by illuminating the contents of the inner container with a light source and measuring the absorbed or emitted light, or by producing a characteristic chemiluminescence which can be detected by a suitable light sensor. The analyte can also be detected amperometrically. Multiple inner containers may be provided into which a plurality of sorbing liquids are respectively introduced for simultaneously detecting different analytes. Baffles may be provided in the outer container. A calibration technique is disclosed.

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Refer also to citation(s) 42323, 42626, 42963, 42965, 42966, 42967, 42968, 42969, 42971, 42983, 42985, 42986, 43022, 43027, 43028, 43094, 43098, 43123, 43316

43044 (BARC–1476) **Chemical aspects of rubidium uranium sulphate for its use as a chemical standard for uranium.** Singh Mudher, K.D. (Bhabha Atomic Research Centre, Bombay (India). Fuel Chemistry Div.); Khandekar, R.R.; Krishnan, K.; Jayadevan, N.C.; Sood, D.D. Bhabha Atomic Research Centre, Bombay (India). 1989. 25p. Order Number DE90635148. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

$Rb_2U(SO_4)_3$, a double sulphate of rubidium and uranium(IV) has been prepared and investigated for its use as a chemical standard for uranium. The compound can be easily prepared and crystallised in a pure form. The results of physico-chemical characterisation on preparation of 5-10 g. lots are described in this report. These studies suggest that the compound is anhydrous, stoichiometric, stable to atmospheric effects and easily soluble in acids and thus satisfies most of the criteria for a primary standard. (author). 13 refs., 4 figs., 6 tabs.

43045 (DOE/ER/13463–7) **Novel macrocyclic carriers for proton-coupled liquid membrane transport: Progress report, December 1, 1987–November 30, 1990.** Lamb, J.D.; Bradshaw, J.S.; Izatt, R.M. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. Aug 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13463. Order Number DE90015529. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This progress report describes work accomplished in our project during the past 12 months. The research is divided into two principal parts: synthesis of macrocyclic compounds, and liquid membrane experiments. Manuscripts describing this work are listed in Part III of this report.

43046 (DOE/ER/13829–3) **[A study of catalysts and mechanisms in synthesis reactions]: [Progress report].** Texas A and M Univ., College Station, TX (USA). Dept. of Chemistry. [1990]. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13829. Order Number DE90015064. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent interest in the partial oxidation of alkanes has focused attention on the role of surface-generated gas-phase radicals in catalysis. During the oxidative coupling of methane the importance of gas phase CH_3· radicals has been demonstrated using a matrix-isolation electron spin resonance (MIESR) system. This technique will be employed to study several important problems associated with the formation and reactions of hydrocarbon radicals. The production of gas phase propyl radicals over a V-MgO-O catalyst will be investigated to determine the intermediate that is responsible for the observed heterogeneous-homogeneous reaction. The nonoxidative formation of hydrocarbon radicals over supported CrO will be explored to establish whether radical reactions over this catalyst involve gas phase intermediates. In the proposed experiments the cross coupling of methyl radicals with benzyl, allyl, 1-methylallyl and 2-methylallyl radicals will be investigated, again to determine the role of surface-generated gas-phase radicals in these reactions. Secondary reactions of radicals with metal oxide surfaces often dictate product selectivity, therefore reactive sticking coefficients for methyl and allyl radicals colliding with metal oxides will be determined. Such quantitative information is essential for modeling complex heterogeneous-homogeneous reactions. A newly constructed laser-induced fluorescence (LIF) spectrometer will be used to complement the data obtained using the MIESR technique. An initial LIF investigation will focus on the OH· radical, which is a key intermediate in hydrocarbon oxidation reactions. The research will be extended to include CH and possibly CH_2 radicals. The proposed projects will provide conceptual information and quantitative data on an important class of catalytic reactions. 29 refs., 5 figs.

43047 (ORNL/TM–11577) **Determination of the solubility of solid CCl_4 in supercritical CF_4 subambient temperature.** Barber, T.A. (Tennessee Univ., Knoxville, TN (USA). Dept. of Chemical Engineering); Bienkowski, P.R.; Cochran, H.D. Oak Ridge National Lab., TN (USA). Jul 1990. 119p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014773. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Thesis submitted by T.A. Barber to Univ. of Tennessee.

A dynamic experimental apparatus developed for supercritical fluid studies was used to determine the solubility of solid CCl_4 in supercritical CF_4. An on-line quadrupole mass spectrometer was utilized for analysis of the effluent. The direct coupling of supercritical extraction with mass spectrometry offers a quantitative method for the direct determination of the solute mole fraction in the supercritical fluid. Valid data were obtained for two isotherms at 244K and 249K. Solubilities were found to range from 5.1×10^{-4} to 2.58×10^{-2} mole fraction. These data will broaden the data base to support the testing of new theoretical models for predicting supercritical behavior. This study successfully correlated the data by two different computational approaches: the compressed gas model and the Kirkwood-Buff fluctuation integral model. As the critical point for CF_4 is 227.6 K, these data are among the few supercritical solubility data available at subambient temperature. 67 refs., 22 figs., 6 tabs.

43048 Highly excited vibrations and resonances of triatomic systems via the discrete variable representation. Light, J.C. (Univ. of Chicago, IL (USA)); Choi, S.E.; Franck, J. pp. 6 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract FG02-87ER13679. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Highly vibrationally excited molecules undergo large amplitude motions such that analysis in terms of harmonic vibrations of normal modes becomes inapplicable. The use of orthogonal (scattering) coordinates permits one to write the Hamiltonian operator explicitly for such motions. The discrete variable representation (DVR) is not a good zero order approximation (as are normal or local modes). However, the DVR in three dimensions (for the internal motions of a triatomic molecule) permits one to evaluate the Hamiltonian matrix for the 3D system in a very simple, very sparse form for a very large (> 30,000 function) direct product basis. Applications to HCN/HNC (J = 0) and to high vibration-rotation states of water will be presented. Calculation of resonance states and lifetimes from a single L^2 calculation will be presented for ArHCl.

43049 Detailed simulation of D + H_2 -> DH + H differential cross sections using quantum scattering calculations. Continetti, R.E. (Univ. of California, Berkeley (USA)); Balko, B.A.; Lee, Y.T. pp. 7 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC03-76SF00098. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Extensive measurements of doubly-differential (velocity-angle) cross sections for the reaction D + H_2 -> DH + H at collision energies of 0.51 and 0.98 eV have been made using a crossed-molecular beams apparatus with a rotatable mass-spectrometric detector. A D atom beam generated by excimer laser photolysis of DI has provided the collision energy resolution necessary to resolve DH product vibrational states. A detailed Monte Carlo simulation of the experiment combined with the recently reported 3-d quantum scattering calculations of Zhang and Miller have provided one of the most critical tests of their understanding of this elementary reaction to date. The overall agreement between theory and experiment is good.

43050 Adsorbate binding energies and entropies: Ammonia on transition metal clusters. Klots, T.D. (Argonne National Lab., IL (USA)); Winter, B.J.; Parks, E.K.; Riley, S.J. pp. 10 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Recently, the authors have made measurements on the temperature dependence of the equilibrium constant, K_{eq}, for the adsorption reaction of ammonia with cobalt and nickel clusters, e.g., $Co_n(NH_3)_{m-1} + NH_3 \rightleftharpoons Co_n(NH_3)_m$. K_{eq} is determined from the ratio of $[Co_n(NH_3)_{m-1}]$ to $[Co_n(NH_3)_m]$ derived from mass spectrum peak intensities and the partial pressure of NH_3 in the flow tube. From the slope and intercept of a van't Hoff plot ($\ln K_{eq}$ vs. 1/T), they obtain values for the standard enthalpy $\Delta H°$ and entropy $\Delta S°$ changes.

43051 Desorption of vibrationally excited adsorbates in competition with relaxation: Classical and quantal pictures.

Guan, Y. (Brookhaven National Lab., Upton, NY (USA)); Muckerman, J.T.; User, T. pp. 12 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors have investigated the processes of desorption and relaxation of vibrationally excited diatomic molecules on solid surfaces by using methods of quantum wavepacket propagation and classical trajectories. They set up a simple, microscopic collinear model for the vibrational predesorption. This talk will discuss the dependence of desorption and relaxation rates on various parameters of the collinear model: the Debye frequency of the solid, the length of the GLE heat bath chain, the surface temperature, and the strength of the adsorbate-surface coupling.

43052 Direct dynamics of S_N2 reactions using variational transition state theory and semiempirical molecular orbital theories. Gonzalez-Lafont, A. (Univ. of Minnesota, Minneapolis (USA)); Truong, T.N.; Truhlar, D.G. pp. 24 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors are applying variational transition state theory to chemical reactions in gas-phase clusters, which fill a wide gap between reactions in the gas-phase and in solution. The reactions of clusters therefore provide important microscopic information about solvation. In particular they are studying the hydrated cluster S_N2 reactions $Cl^-(H_2O)_n(g) + CH_3Cl(g)$, $OH^-(H_2O)_n(g) + CH_3Cl(g)$, and $Br^-(H_2O)n(g) + CH_3Cl(g)$, with n = 0-2. The authors are using semiempirical molecular orbital theory to evaluate the potential energy surfaces along the reaction paths, with all of the coordinates of the systems treated explicitly. Comparisons will be made with previous dynamical calculations based on ab initio potential energy surfaces as well as with experimental data.

43053 Recent progress in accurate 3D quantum reaction dynamics using hyperspherical (APH) coordinates. Kress, J.D. (Los Alamos National Lab., NM (USA)); Padkjaer, S.B.; Pack, R.T.; Parker, G.A. pp. 28 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Recent results of accurate 3D quantum reactive scattering calculations using the Adiabatically adjusting Principal axes Hyperspherical (APH) theory are described. The authors have now implemented three techniques for generating bases of sector adiabatic surface functions: the finite element method, the discrete variable representation (DVR) method, and an analytic basis function method. Results for some of the following reactions will be reported: $F + H_2$, $F + D_2$, $He + H_2^+$, Li + HF and muonic tritium plus D_2 ($t\mu + D_2$).

43054 Time-delayed picosecond absorption spectra of dissociating polyatomic molecules. Lyman, J.L. (Los Alamos National Lab., NM (USA)); Gosnell, T.R.; Taylor, A.J. pp. 30 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors have obtained the absorption spectrum of dissociating CF_2Br_2 at successive times after absorption of an intense picosecond KrF (248.4 nm) laser pulse. The light source for the absorption spectrum is a frequency continuum generated by focusing part of the laser pulse into high pressure krypton gas. The main absorption feature was that of the CF_2 photofragment, which has several strong absorption bands in the spectral region probed (254 to 267 nm). They infer a reaction time from the appearance of the CF_2 spectrum. These observations lead to conclusions about the mechanism of the photochemical reaction, the nature of the reaction transition state, and the energy barrier of the photochemical reaction. This technique provides a useful tool for the study of fast photochemical processes.

43055 Improved methods for reaction path calculations in chemical dynamics. Melissas, V.S. (Univ. of Minnesota, Minneapolis (USA)); Truhlar, D.G.; Garrett, B.C. pp. 32 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Several algorithms for computing minimum energy reaction paths by the method of steepest descents of the potential energy will be described. The authors have made a systematic survey of higher order, adaptive and non-adaptive, stiff and nonstiff algorithms to document their efficiency with respect to allowing larger step sizes, thereby decreasing the number of gradient evaluations (which are often very expensive). The authors have also tested the efficiency using the hessian in the calculation of the reaction path, as suggested by Page and McIver. The efficiencies of the various algorithms will be demonstrated and compared by application to the abstraction reaction $CH_3 + H_2 \rightarrow CH_4 + H$, which is considered as a prototype organic reaction.

43056 Dynamics of twisted-intramolecular charge transfer in dimethylaminobenzonitrile. Schenter, G.K. (Pacific Northwest Lab., Richland, WA (USA)); Duke, C.B. pp. 37 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

A new model of twisted intramolecular charge transfer (TICT) of dimethylaminobenzonitrile (DMABN) in polar solvents is developed which explicitly accounts for the coupling of the twisting dynamics to the solvent dielectric response. This is achieved through a set of coupled Langevin equations describing the twisting and solvent motion. These equations are numerically integrated to give a quantitative description of experimental measurements describing the dynamics of TICT for DMABN in propanol. Observed time dependent fluorescence and Stokes shift are reproduced.

43057 Br^* + CO_2 revisited: An interrogation of the E-V transfer with time-resolved diode laser spectroscopy. Sedlacek, A.J. (Brookhaven National Lab., Upton, NY (USA)); Weston, R.E. Jr.; Flynn, G.W. pp. 38 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC02-76CH00016 ;FG02-88ER13937. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Time-resolved diode laser spectroscopy has been used to reinvestigate the electronic-vibrational energy transfer from spin-orbit excited bromine, $Br(^2P_{1/2})$, to carbon dioxide. The experiments are carried out by generating the Br^* atoms with pulsed 193 nm laser photolysis of CF_3Br and monitoring the subsequent energy transfer by following the temporal evolution of selected vibrational states of CO_2 (10^01, 02^01, 02^21 and 00^01). By comparing the temporal profile of the 10^01 state with that predicted by various kinetic models it has been established that the quenching of Br^* by CO_2 occurs via the nearly resonance 10^01 state.

43058 Ab initio FORS-MCSCF potential energy surfaces governing chemical reactions involving C and O. Xantheas, S.S. (Iowa State Univ., Ames (USA)); Ruedenberg, K. pp. 41-42 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The potential energy surfaces governing the chemical reactions $CO_\alpha + O_\beta \rightarrow CO_\beta + O_\alpha$ and $C + O_2 \rightarrow CO + O$ are computed within the full valence space FORS-MCSCF framework. An unbiased accurate description of the electronic wavefunction is obtained by including all 16 valence electrons in the FORS model consisting of MCSCF calculations in the full space of all possible (35793) symmetry restricted (C_s) configurations of the valence orbital space. An extended basis set with polarization functions on both carbon and oxygen is used throughout.

43059 Large amplitude motion in C_3 studied by stimulated emission pumping spectroscopy. Northup, F.J. (Brookhaven

National Lab., Upton, NY (USA)); Sears, T.J.; Rohlfing, E.A.; Goldsmith, J.E.M. pp. 46 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC02-76CH00016. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

A systematic study of vibrationally excited states of the C_3 molecule cooled to rotational temperatures of a few degrees Kelvin in a pulsed supersonic free jet expansion has been made. Bending states with more than 40 vibrational quanta have been observed and SEP has enabled measurement of rotational structure in many of the levels including some with ~4,500 cm^{-1} of bending vibrational energy. Other experiments have accessed stretch-bend combination levels of similar and even higher energies. Results imply that any barrier to linearity in the potential surface at equilibrium is very small, probably less than 10 cm^{-1}. Recent results from Brookhaven and Sandia National Labs will be presented and their interpretation discussed in terms of the ground state potential surface of the molecule.

43060 A theoretical study of the harmonic vibrational frequencies of SiO_4H_4: Model surfaces for silicates. Sosa, C. (Pacific Northwest Lab., Richland, WA (USA)); Ferris, K.F. pp. 52-53 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC06-76RL01830. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Absolute infrared intensities of orthosilicic acid ($Si(OH)_4$) as a model of surface hydroxyls in silica have been studied using ab initio techniques. Structural differences and the shifting in the vibrational frequencies have been studied by introducing additional -SiOH groups as well as water molecules. All the geometries have been optimized with split-valence (3-21G) basis set. The orthosilicic acid has also been optimized with DZP basis set. Vibrational frequencies and absolute infrared intensities have been computed at the SCF level. The effects of correlation corrections as well as the effect of anharmonicities have been approximated by scaling the vibrational frequencies.

43061 Dim study of the H_2F_2 potential energy surface. Bradburn, B.A. (Univ. of New Mexico, Albuquerque (USA)); Walters, E.A.; Blais, N.C.; Kuntz, P.J. pp. 58 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Models of the mechanism of the reaction $H_2 + F_2 \rightarrow 2\ HF$ have implicated the elementary reaction $H_2 + F_2 \rightarrow HF + H + F$ as being of fundamental importance. Little experimental or theoretical information is available for this step, however. In order to examine this reaction channel and the possibility that a surface crossing is involved, the authors have carried out a DIM calculation of the lowest lying potential energy surfaces of the H_2F_2 system.

43062 Nitrogen laser photoionization quadrupole mass spectrometry: Application to two-photon compounds. Gibson, J.K. (Oak Ridge National Lab., TN (USA)). pp. 62-63 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC05-84OR21400. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

A photoionization mass spectrometer has been developed using a quadrupole mass filter and a pulsed nitrogen laser photon source. Design of this system provides for study of the highly radioactive transplutonium elements but initial investigations have been on organic species with ionization potentials below the energy of two N_2-laser photons (3.68 eV/photon). This system allows mass spectra to be obtained using laser ionization, electron impact ionization, or simultaneous laser and electron impact ionization; mass spectra derived using each of these methods will be compared. Phenomena specific to the simultaneous laser and electron impact ionization mode of operation will be described and other relevant parameters will be discussed.

43063 Electrostatic models of solvent molecules. Kober, E.M. (Los Alamos National Lab., NM (USA)); Faloona, I.C.; Ritchie, J.P. pp. 67 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The electrostatic forces between solute and solvent molecules and between the solvent molecules themselves are extremely important in properly describing the solvent effects on chemical reactions, even for relatively non-polar solvents such as hydrocarbons. A simple approach to describe such interactions is to use atomic point charges based on Mulliken population analyses. A much more exact treatment is to use Atom Centered Multipole Expansion (ACME's) which include the higher atomic multipoles (typically through octupoles or hexadecapoles). A comparison of these approaches shows that while the simple point charge approach can sometimes provide a good estimate of the energy of interaction, the higher multipole moments give a much improved description of the interaction, particularly with regards to the more subtle aspects of the directionality. This electrostatic model is found to provide a good description of hydrogen-bonding interactions, and to explain some of the properties of chloro- and fluoro-carbons.

43064 Semiclassical spectra of polyatomic molecules: Application to water and acetylene. Shirts, R.B. (EG and G Idaho, Inc., Idaho Falls (USA)); Pickett, T.J. pp. 75 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC07-76ID01570. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors present an improved method to calculate infrared spectra of polyatomic molecules and ions in the gas phase. Needed inputs are a potential energy surface and a parametrization of the dipole moment as a function of coordinates. Using the FFT of classical coordinates and momenta, quantizing trajectories are found independent of any separability of the Hamiltonian. Intensities of infrared transitions are calculated using Fourier amplitudes of the dipole moment as approximations to matrix elements. The main improvement they report is an improved windowing technique through which they routinely achieve 13 place accuracy in standard test cases. This advance allows one to achieve semiclassical accuracy in computed spectral frequencies and intensities.

43065 Chemical models for state-to-state unimolecular reactions I. Chen, Chia (Lawrence Berkeley Lab., CA (USA)); Green, W. Jr.; Kim, Sang Kyu; Mahoney, A.J.; Moore, C.B.; Zheng, Qi-Ke. pp. 81 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The dissociation of ketene on its singlet and triplet surfaces is investigated, photofragment excitation spectroscopy ($^1CH_2$ detection) and photofragment (laser-induced fluorescence detection) CO(v,J) distributions are used to characterize the dissociation processes. Results are used to develop and quantitatively test models for product energy distributions and absolute reaction rates. Comparison to phase space theory and variants of RRKM theory are discussed.

43066 Reaction paths on energy surfaces governing chemical reactions. Ruedenberg, K. (Iowa State Univ., Ames (USA)). pp. 84 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

A full theoretical understanding of many reactions requires the examination of considerable parts of the global energy surface in terms of an appropriate set of internal coordinates. As an example, the energy surface of the ring opening (cyclopropylidene) → (allene), obtained by MCSCF calculations in the full configuration space of the reacting electrons, is illustrated in terms of three coordinates, the ring opening angle and the two angles describing the CH_2 rotations. Alternative definitions of the reaction path are discussed. In the example, the reaction path bifurcates in the neighborhood of the transition state. A general analysis and classification of bifurcations and their relation to transition states is given.

43067 Reaction path analysis of molecular potential energy surfaces. Dunning, T.H. Jr. (Pacific Northwest Lab., Richland, WA (USA)); Kraka, E. pp. 84 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

While it is true that the potential energy surface controls the dynamics of chemical reactions, in reality the connection may not be at all obvious. The complexity of molecular potential energy surfaces, for which the energy is a function of (3N-6) internal coordinates, prevents their ready visualization and analysis. However, from the shape and coupling terms in the reaction path Hamiltonian, it is possible to understand many of the qualitative features of reaction dynamics. Therefore, comparison of the terms in the reaction path Hamiltonian for two different potential energy surfaces can reveal any substantative differences between the surfaces. In addition, a reaction path analysis of an analytic fit of a potential energy surface can pinpoint possible problems with the fit. Potential energy surfaces for a number of reactions, including H + H_2, OH + H_2 and Li + HF, will be analyzed and compared.

43068 Reaction path studies of large amplitude vibrations. Harding, L.B. (Argonne National Lab., IL (USA)). pp. 84 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Ab initio, GVB+1+2 calculations, employing a (4s3p2d1f/3s2p) basis set have been used to characterize reaction paths for the torsional mode of hydrogen peroxide and the inversion mode of the vinyl radical. For hydrogen peroxide, the calculated torsional splitting between the lowest pair of torsional states for the ground vibrational state is 11.375 cm^{-1}, in excellent agreement with the observed splitting of 11.437 cm^{-1}. The calculated energies of the next four higher torsional states are found to agree well with the observed levels, the maximum error being 10 cm^{-1} (1%) for the highest state. Results on the effects of vibrational excitation on these torsional energy levels will also be presented.

43069 Reaction dynamics of D + H_2 → DH + H. Continetti, R.E. (Lawrence Berkeley Lab., CA (USA)); Balko, B.A.; Lee, Y.T. pp. 86 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Progress in molecular beam measurements of differential cross sections for the reaction D + H_2 coupled with accurate quantum scattering calculations on ab initio potential energy surfaces (PESs) has provided a detailed test of the reaction dynamics of this elementary reaction and the PES on which it occurs. Recent experiments in their laboratory have been compared to accurate quantum scattering calculations at collision energies near 0.5 and 1.0 eV. The theoretical predictions generally fit the experimental results very well, however, significant discrepancies were observed for rotationally excited DH differential cross sections. The implications of these results for the PES of this system will be discussed.

43070 State-resolved dynamics of radical reactions by cross-molecular beam approach. Liu, Kopin (Argonne National Lab., IL (USA)). pp. 86 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

An overview of the recent experiments on the state-to-state integral cross section measurements in a new crossed-beam apparatus will be presented. This includes the inelastic scatterings of CH($X^2\Pi$) + He and D_2, OH($X^2\Pi$) + CO and N_2, and the reactive scatterings of CH($X^2\Pi$) + D_2 and CN($X^2\Sigma^+$)+O_2. Two types of measurements were performed: (1) the product state distribution at a fixed and well-defined collision energy and (2) the dependence on collision energy of product state-resolved cross sections.

43071 Theoretical studies of addition reactions of small radicals. Wagner, A.F. (Argonne National Lab., IL (USA)); Bowman, J.M.; Gazdy, B. pp. 90 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38 ;FG05-86ER13568. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Usually, addition reactions proceed via a complex whose resonance widths are broader than the energy spacing between metastable states. However, for H+CO, quantum dynamics calculations on a realistic ab initio potential energy surface have shown that at least some of the HCO* resonances are isolated for total angular momentum J=0. These calculations have been extended for both J=0 and 1. Also, new exact quantum bound state calculations of HCO have been completed and allow both extrapolation of metastable energy levels as well as direct characterization of these virtual levels by stabilization techniques. Together, these calculations begin to establish the metastable spectroscopy of HCO* and its dynamical consequences through unimolecular decay.

43072 The magic of chemistry: Cluster structure revealed through adsorbate binding patterns. Riley, S.J. (Argonne National Lab., IL (USA)); Parks, E.K.; Klots, T.D.; Winter, B.J. pp. 92 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

When association reactions between clusters and small molecules occur under equilibrium conditions, the pattern of adsorbate binding can be a sensitive function of the cluster-adsorbate binding energy. If particular sites on the cluster surface can be identified as being preferred, i.e., having enhanced binding energy for a given adsorbate, then a count of the preferred number of adsorbate molecules gives a count of the number of such sites. This puts constraints on possible cluster geometrical structures. Adsorbate binding patterns can also be used to identify magic numbers in clusters. Examples of these effects will be presented, including the reactions of bare and hydrogenated cobalt and nickel clusters with ammonia and with water.

43073 Reaction dynamics on metal surfaces and clusters. Stave, M.S. (Iowa State Univ., Ames (USA)); Fournier, R.; De-Pristo, A.E. pp. 92 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-7405-ENG-82. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors will describe the theoretical methods developed in their group for the study of reaction dynamics and structures in metal clusters. The central part will focus on the similarities and differences for dissociative chemisorption on metal clusters and surfaces. This will include recent results on the reaction, D_2/Ni_n → $2D(a)/Ni_n$, for both rigid and non-rigid Ni clusters with N=3-100. Preliminary results on the structure and dynamics of bimetallic clusters will also be shown.

43074 Dynamics and structure of nickel clusters. Jellinek, J. (Argonne National Lab., IL (USA)); Garzon, I.L. pp. 94 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Results on dynamical and structural properties of Ni clusters obtained in molecular dynamics simulation studies are presented. The calculations are carried out using the embedded atom approach as well as a novel scheme based on size-dependent potentials. The stable geometries of clusters are identified through the technique of thermal quenching. Specificity of the solid-like-to-liquid-like transition in clusters of different size is discussed. The results are compared, where possible, to experimental data, as well as to simulation data for rare gas clusters.

43075 Why rough surfaces are important for chemical bond breaking and catalysis. Somorjai, G.A. (Lawrence Berkeley Lab.,

CA (USA)). pp. 94 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Surface science and catalytic reaction studies demonstrated that metal surfaces with more open surface structure and with atomic steps and kinks are more reactive. Adsorption induced restructuring is proposed to explain their enhanced reactivity. Surface crystallography and catalytic reaction studies will be discussed to review the experimental evidence for this model.

43076 Analysis of highly excited vibrational eigenstates and spectra. Davis, M.J. (Argonne National Lab., IL (USA)). pp. 83 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Analysis of highly excited vibrational eigenstates and spectra is presented. In the case of the eigenstates particular attention will be paid to the connection between the classical motion and the nature of the quantum eigenstates, including regions where the classical motion is chaotic. This analysis centers around the classical phase space structure present in classically chaotic regions of phase space. Two types of analysis of complicated spectra will be discussed. These are the complexity of spectra based on their hierarchical nature and the information content of spectra. The latter involves the embedding of the Fourier transform of spectra into a phase space.

43077 Dynamics calculations based on reaction path methods: Techniques and applications. Garrett, B.C. (Pacific Northwest Lab., Richland, WA (USA)). pp. 89 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

An analysis and numerical tests of the difference in harmonic reaction-path potentials for distinct coordinate choices for reaction-path Hamiltonians is presented for three-dimensional atom-diatom collisions with collinear steepest descent paths and for the CH_3 + H_2 reaction. Variational transition state theory (VTST) with semiclassical ground-state tunneling corrections is used to test the importance of the differences in the harmonic frequencies upon calculations of thermal rate constants. The extension of the reaction path approach for tunneling calculations by the large-curvature tunneling method is discussed. Applications of these methods are presented for the reactions H + NH_3, CH + H_2, and CN + H_2O.

43078 On structure, phase transformations, electron localization and reactions of clusters. Landman, U. (Georgia Institute of Technology, Atlanta (USA)). pp. 102 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Structural, thermodynamic, spectroscopic and chemical properties of clusters often exhibit size dependencies whose systematic investigations open new avenues toward understanding the physics and chemistry of finite aggregates as well as elucidate the evolution of condensed phase systems. In this talk the authors focus on the development and applications of classical and quantum methods of simulations for studies of metallic, ionic and molecular clusters.

43079 Organometallic acceptors in molecular-based materials: Field-dependent magnetic behavior of an organovanadium charge-transfer salt. Morse, D.B. (Univ. of Illinois, Urbana (USA)). *Journal of Physical Chemistry (USA),* 2(1): 33-38 (Jan-Feb 1990). DOE Contract AC02-76ER01198.

The reaction of 2 equiv of tetramethyltetrathiofulvalene (TmTTF) with the organometallic acceptor (methylcyclopentadienyl)vanadium trichloride, $(MeCp)VCl_3$, followed by partial oxidation affords $[TmTTF]_3[((MeCp)VCl_2)_2(\mu\text{-}O)]_2$ (1). The full structural parameters are reported with special emphasis on the mixed valence nature of both the cation $[[TmTTF]_3^{2+}]$ and anion $([((MeCp)VCl_2)_2O]^-)$ subunits, as well as the relationship of the two stacks within the lattice. Oriented single-crystal magnetic susceptibility data indicate that 1 develops weak ferromagnetic interactions along two dimensions (XY) at small applied fields (50 G). This behavior is dominant between 50 and 3 K. Crushed single-crystal samples require a higher applied field to induce the cooperative interactions. These cooperative interactions are suppressed at high applied fields. The zero-field ground state of 1 at 1.8 K is antiferromagnetic.

43080 Binding modes of distamycin A with $d(CGCAAATTTGCG)_2$ determined by two-dimensional NMR. Pelton, J.G. (Lawrence Berkeley Lab., CA (USA)); Wemmer, D.E. *Journal of the American Chemical Society (USA),* 112(4): 1393-1399 (14 Feb 1990).

Two-dimensional nuclear Overhauser effect spectroscopy (NOESY) was used to study the interaction of distamycin A with $d(CGCAAATTTGCG)_2$. Spectra acquired at several points in a titration of the dodecamer with distamycin A were used to assign resonances, to determine drug-drug and drug-DNA contact points, and to monitor exchange of the drug between binding sites. NOEs from drug pyrrole H3 to DNA C1′H and adenine C2H protons, as well as observed line width changes of the DNA protons as a function of temperature, were consistent with a model in which two drugs bind simultaneously, overlapping in the minor groove, with each drug sliding between 5′-AATT-3′ and 5′-ATTT-3′ binding sites at a rate fast on the NMR time scale. Molecular modeling of the 2:1 complexes indicates that the minor groove must expand, relative to the 1:1 complex, to accommodate both drugs, indicating that the phosphate backbone can be distorted in response to ligand binding. Distance-constrained energy refinement of the 2:1 complexes indicates that electrostatic interactions, hydrogen bonds between the drugs and the DNA, and both drug-drug and drug-DNA stacking interactions all contribute to stabilization of the complex. Comparisons are made with crystallographic studies of this drug and dodecamer. Implications of the 2:1 binding mode for other studies and possibilities for the design of new sequence-specific recognition complexes are discussed.

43081 Ethylene insertion and β-hydrogen elimination for permethylscandocene alkyl complexes. A study of the chain propagation and termination steps in Ziegler-Natta polymerization of ethylene. Burger, B.J. (California Institute of Technology, Pasadena (USA)); Thompson, M.E.; Cotter, W.D.; Bercaw, J.E. *Journal of the American Chemical Society (USA),* 112(4): 1566-1577 (14 Feb 1990).

The rates of ethylene insertion into the Sc-C bond for Cp^*_2ScR (Cp^* = $(\eta^5\text{-}C_5Me_5)$, R = CH_3, CH_2CH_3, $CH_2CH_2CH_3$) have been measured at −80°C by ^{13}C NMR; the second order rate constants ($M^{-1}\cdot s^{-1}$) are as follows: R = CH_3, 8.1 (2) × 10^{-4}; R = CH_2CH_3, 4.4(2) × 10^{-4}; R = $CH_2CH_2CH_3$, 6.1 (2) × 10^{-3}. The slow rate for the $ScCH_{22}CH_3$ complex is attributed to a ground-state stabilization by a β-C-H agostic interaction. The distributions of molecular weights for ethylene oligomers ($CH_3(CH_2)_nCH_3$, n = 11-47) produced from known amounts of ethylene and $Cp^*_2ScCH_2CH_2CH_3$ at −80°C satisfactorily fit a Poisson distribution, indicative of a living Ziegler-Natta polymerization system.

43082 Spectroscopy of CH_3CO^- and CH_3CO. Nimlos, M.R. (Univ. of Colorado, Boulder (USA)); Ellison, G.B.; Soderquist, J.A. *Journal of the American Chemical Society (USA),* 111(20): 7675-7681 (27 Nov 1989).

The authors have measured the photoelectron spectra of CH_3CO^- and CH_2DCO^- and find the following electron affinities: EA(CH_3CO) = 0.423 ± 0.037 eV and EA(CH_2DCO) = 0.418 ± 0.038 eV. The spectra show excitation in the C-C-O bending vibration of the radical, and we have measured the following bending frequencies: $\nu_{11}(CH_3CO)$ = 490 ± 30 cm^{-1}, $\nu_{11}(CH_2DCO)$ = 500 ± 50 cm^{-1}, and $\nu_{11}(CH_3CO^-)$ = 570 ± 180 cm^{-1}. From a Franck-Condon analysis of the vibronic peak intensities we have estimated these C-C-O bond angles for the acetyl anion and radical: $\alpha(CCO)[CH_3CO^-]$ = 110 ± 5° and $\alpha(CCO)[CH_3CO]$ = 133 ± 5°. Finally, the electron affinities we have measured can be used to determine the thermodynamic parameters.

43083 Molecular sieve sensors for selective detection at the nanogram level. Bein, T. (Univ. of New Mexico, Albuquerque (USA)); Brown, K.; Frye, G.C.; Brinker, C.J. *Journal of the American Chemical Society (USA),* 111(19): 7640-7641 (13 Sep 1989).

Zeolites have long been known for their molecular sieving properties based upon crystalline pore structures of molecular dimensions. The authors explore strategies to introduce molecular sieving functions into inorganic thin films and membranes which are of current interest for sensor coatings and gas-phase separations. The zeolite films offer high thermal stability (> 770 K) and chemical resistance. Surface acoustic wave devices can be operated as highly sensitive piezoelectric balances that respond to small fractions of single-crystal monolayer adsorption via frequency changes of an oscillator circuit. Since the response is nonselective, a number of organic and organometallic coatings on SAW devices have previously been explored to impart chemical selectivity. The SAW device (97 MHz, detection limit ca. 100 pg/cm^2) used in the present study to measure selective adsorption of organic vapors (0.1% of saturation in nitrogen flow, 295 K) consists of a single-crystal quartz substrate with interdigital transducers which was coated with zeolite-silica thin films and mounted in a test chamber with gas inlet and outlet.

43084 Transient binding of photodissociated CO to Cu_B^+ of eukaryotic cytochrome oxidase at ambient temperature. Direct evidence from time-resolved infrared spectroscopy. Dyer, R.B. (Los Alamos National Lab., NM (USA)); Einarsdottir, O.; Killough, P.M.; Lopez-Garriga, J.J.; Woodruff, W.H. *Journal of the American Chemical Society (USA)*, 111(19): 7657-7659 (13 Sep 1989).

The reactions of CO with the metal centers of cytochrome oxidase exemplify the mechanisms open to O_2 and other small-molecule ligands. In particular, the fast reactions following photodissociation of CO from cytochrome a_3 yield important information about the pathways available to ligands to and from the active site. FTIR studies have demonstrated that, below 180 K, photodissociated CO binds to Cu_B^+ both in mitochondrial preparations and in the detergent-solubilized enzyme. We have also observed Cu_B^+-CO in the room temperature FTIR spectrum of cytochrome ba_3 from Thermus thermophilus. In this report we present the first direct, ambient temperature evidence that CO does indeed bind to Cu_B^+. This conclusion is based upon the observation of the transient infrared absorbance due to the C-O stretching vibration of Cu_B^+-CO, following photodissociation of CO from heme a_3. We observe that the transient Cu_B^+-CO complex equilibrates with its surroundings on a short time scale, losing CO into solution with a half-life of 1.5 μs.

43085 Synthesis and structure of a capped square-pyramidal five-metal oxo cluster, $[Fe_2Ru_3(CO)_{14}(\mu_4\text{-}O)]^{2-}$. Schauer, C.K. (Northwestern Univ., Evanston, IL (USA)); Voss, E.J.; Sabat, M.; Shriver, D.F. *Journal of the American Chemical Society (USA)*, 111(19): 7662-7664 (13 Sep 1989).

Main-group heteroatoms in low oxidation state organometallic cluster compounds are generally found in either interior positions or on the periphery as part of the cluster skeleton. Organometallic clusters containing the oxo ligand are much less numerous than organometallic carbides, nitrides, and sulfides. Until recently the highest coordination number of oxygen in an organometallic cluster was three. Recently we found four-coordinate oxygen in a metal butterfly cluster. We now describe the synthesis and characterization of a five-metal oxo cluster, $[Fe_2Ru_3(CO)_{14}(\mu_4\text{-}O)]^{2-}$. The five-metal environment presents the possibility of a five-coordinate heteroatom which is situated nearly in the square-basal plane, or a four-coordinate heteroatom capping the square base.

43086 Cleavage of SO_2 on $(\eta^5\text{-}C_5Me_5)_2Mo_2(\mu\text{-}S_2)(\mu\text{-}S)_2$ to form S_8 and a thiosulfate complex, $(\eta^5\text{-}C_5Me_5)_2Mo_2(\mu\text{-}S_2)(\mu\text{-}S)(\mu\text{-}SSO_3)$. Possible role in homogeneous hydrogenation of SO_2 catalyzed by Mo-S complexes. Kubas, G.J. (Los Alamos National Lab., CA (USA)); Ryan, R.R.; Kubat-martin, K.A. *Journal of the American Chemical Society (USA)*, 111(20): 7823-7832 (27 Nov 1989).

Reaction of SO_2 with solutions of $Cp^*_2Mo_2(\mu\text{-}S_2)(\mu\text{-}S)_2$ (1) initially yields 1-SO_2, which is shown by crystallography to contain an SO_2 weakly bound to a μ-S (S-S = 2.60 Å). SO_2 further reacts with 1-SO_2 to quantitatively give $Cp^*_2Mo_2(\mu\text{-}S_2)(\mu\text{-}S)(\mu\text{-}SSO_3)$ (2), which now contains an SO_3 bound to the μ-S (S-S = 2.17 Å). Effectively, a μ-S_2O_3 (thiosulfate) ligand is formed by an oxygen-transfer process, and the source of the oxygen as established by ^{18}O labeling is SO_2. S_8 is also produced, showing that SO_2 has undergone net disproportionation to SO_3 and S_8.

43087 Preparation of tert-butyl-capped polyenes containing up to 15 double bonds. Knoll, K. (Massachusetts Institute of Technology, Cambridge (USA)); Schrock, R.R. *Journal of the American Chemical Society (USA)*, 111(20): 7989-8004 (27 Nov 1989).

7,8-Bis(trifluoromethyl)tricyclo[4.2.2.0^{2,5}]deca-3,7,9-triene (TCDT) can be ring-opened in a controlled manner by W(CH-t-Bu)(NAr)(O-t-Bu)$_2$ (Ar = 2,6-C_6H_3-i-Pr_2) to give living oligomers from which the metal can be removed in a Wittig-like reaction with pivaldehyde or 4,4-dimethyl-trans-2-pentenal. Mixtures of odd and even polyenes have been analyzed by reversed-phase HPLC methods, and those having as many as 13 double bonds have been isolated by column chromatography on silica gel under dinitrogen at −40°C and characterized by ^1H and ^{13}C NMR and UV-vis studies. The 17-ene has been observed by HPLC. Polyenes containing more than 17 double bonds are relatively unstable under the reaction and subsequent isolation conditions; those containing between 11 and 15 double bonds decompose thermally progressively more readily. UV-vis and ^{13}C and ^1H NMR data have been collected and analyzed in detail for the trans(cis,trans)$_x$ isomers for x = 1-5 (up to 11 double bonds) and for the odd and even all-trans forms containing up to nine double bonds.

43088 A novel coordination mode for oxygen: Preparation and properties of $(NBu^n_4)_2[V_4O(edt)_2Cl_8]$ containing a square-planar oxide bridge. Rambo, J.R. (Indiana Univ., Bloomington (USA)); Huffmann, J.C.; Christou, G.; Eisenstein, O. *Journal of the American Chemical Society (USA)*, 111(20): 8027-8029 (27 Nov 1989).

The authors are currently engaged in a program directed toward the development of V/S chemistry. In earlier reports we described several V/S complexes encompassing nuclearities 1-4 and oxidation levels III-V, including mixed valency. In subsequent studies, we investigated whether lowering of the edt^{2-}; V ratio would yield a mixed Cl^-/edt^{2-} dinuclear complex with a different structural core and wondered how this might affect the V...V separation. We herein report that the product from one such reaction is not dinuclear but tetranuclear, $(NBu^n_4)_2[V_4O(edt)_2Cl_8]$ containing the first example of a square-planar oxide in a molecular species.

43089 Theoretical nets with 18-ring channels: Enumeration, geometrical modeling, and neutron diffraction study of $AlPO_4$-54. Smith, J.V. (Univ. of Chicago, IL (USA)); Pluth, J.J.; Richardson, J.W. Jr. *Journal of Physical Chemistry (USA)*, 93(25): 8212-8219 (14 Dec 1989).

The framework topology of aluminophosphate no. 54 is the same as that of the aluminophosphate-based family of molecular sieves denoted VPI-5. It corresponds to that of theoretical net 81(1), now numbered 520, which has an 18-ring channel. Unit cell parameters for as-synthesized $AlPO_4$-54 are a = 19.009 (2) Å, c = 8.122 (1) Å, V = 2541.63 Å^3. $AlPO_4$-54 dehydrated at 275°C has lattice parameters a = 18.549 (1) Å, c = 8.404 (1) Å, V = 2504.13 Å^3. The crystal structure of dehydrated $AlPO_4$-54 was determined from time-of-flight neutron diffraction data. The 13 theoretical nets with crankshaft chains that fit the hexagonal geometry and cell dimensions of $AlPO_4$-54 were considered as possible models for the structure. The $AlPO_4$-54 framework contains tetrahedrally coordinated Al and P at the vertices of a 3D net obtained by replacing each edge of a $(4.4.18)_1(4.6.18)_2$ 2D net by a crankshaft chain. The average free diameter across the 18-ring channel is 12.5 Å. (Al,P)-O bond distances from the Rietveld refinement range from 1.44 to 1.70 Å with a mean value of 1.60 Å, and (Al,P)-O-(Al,P) angles range from 132 to 180°.

43090 A new population analysis based on atomic polar tensors. Cioslowski, J. (Los Alamos National Lab., NM (USA)). *Journal of the American Chemical Society (USA)*, 111(22): 8333-8336 (25 Oct 1989).

A new population analysis which provides values of atomic charges in molecules is proposed. The atomic charge is related to trace of the corresponding atomic polar tensor (tensor of the derivatives of dipole moment with respect to atomic Cartesian coordinates). The resulting electron populations do not require any direct reference to the basis set used, and they can be calculated

for both HF and correlated wave functions. The charges are computed for several molecules and compared with the results of Mulliken population analysis.

43091 Process for producing organic products containing silicon, hydrogen, nitrogen, and carbon by the direct reaction between elemental silicon and organic amines. Pugar, E.A.; Morgan, P.E.D. To Dept. of Energy, Washington, DC. USA Patent 4914063/A/. 3 Apr 1990. Filed date 4 Apr 1988. USA Patent Application 7-177,270. Int. Cl. C04B 35/56. 12p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A process is disclosed for producing, at a low temperature, a high purity organic reaction product consisting essentially of silicon, hydrogen, nitrogen, and carbon. The process comprises reacting together a particulate elemental high purity silicon with a high purity reactive amine reactant in a liquid state at a temperature of from about 0° C up to about 300° C. A high purity silicon carbide/silicon nitride ceramic product can be formed from this intermediate product at a temperature of from about 1200°–1700° C for a period from about 15 minutes up to about 2 hours or the organic reaction product may be employed in other chemical uses.

4004 Electrochemistry

Refer also to citation(s) 42838, 42839, 42840, 42983, 42988, 43026, 43087, 43140

43092 Directional electron transfer: Conformational interconversions and their effects on observed electron-transfer rate constants. Brunschwig, B.S. (Brookhaven National Lab., Upton, NY (USA)); Sutin, N. *Journal of the American Chemical Society (USA),* 111(19): 7454-7465 (13 Sep 1989). DOE Contract AC02-76CH00016.

The interaction between conformation changes and electron-transfer rates is considered for systems containing two redox centers. The effect of conformation changes on the free-energy barrier to intramolecular electron transfer is examined. Unstable conformers R* of the reactant (or P* of the product) that are either more (low-λ intermediates) or less (high-λ intermediates) redox-active than the stable reactant R (or product P) are considered. The relative energies of the conformers determine whether the observed electron-transfer reaction proceeds by a two-step mechanism involving the intermediate formation of an unstable conformer or by a direct (concerted) reaction involving only the stable reactant and product. The present analysis generates a set of equations that indicate when the two-step or the direct mechanism is energetically favored. Only when the two-step mechanisms are favored is gating or conformational control possible.

43093 Ferromagnetically coupled linear electron-transfer complexes. Structural and magnetic characterization of $[Cr(\eta)^6\text{-}C_6Me_xH_{6-x}^2][TCNE]$ (x = 0, 3, 6) and S = 0 $[TCNE]_2^{2-}$. Miller, J.S. (E.I. du Pont de Nemours and Co., Wilmington, DE (USA)); O'Hare, D.M.; Chakraborty, A.; Epstein, A.J. *Journal of the American Chemical Society (USA),* 111(20): 7853-7860 (27 Nov 1989).

The reaction of $Cr^0(C_6Me_xH_{6-x})_2$ (x = 0, 3, 6), D, with TCNE, A, results in formation of 1:1 electron-transfer salts of $[Cr^1(C_6Me_xH_{6-x})_2][TCNE]$ (x = 0, 3, 6) composition. The x = 0 and 3 complexes have been structurally characterized. The magnetic susceptibility between 2 and 320 K for these $[TCNE]_2^{2-}$ complexes can be fit by the Curie-Weiss law, $\chi = C/(T-\theta)$, for one independent per spin repeat unit. Charge-transfer excitation from the next highest occupied molecular orbital is consistent with the stabilization of ferromagnetic coupling for this system. Thus, other molecular/organic systems with ^2A ground states might be suitable components for a bulk ferromagnet.

43094 Direct polymerization of acetylene to give living polyenes. Schlund, R. (Massachusetts Institute of Technology, Cambridge (USA)); Schrock, R.R.; Crowe, W.E. *Journal of the American Chemical Society (USA),* 111(20): 8004-8006 (27 Nov 1989).

Polyacetylene has been of great interest in the past decade as (inter alia) a potential organic conductor, but so far it has not been possible to prepare polyacetylene or shorter oligomers in a controlled polymerization of acetylene. There is good evidence that this should be possible under the right circumstances by using an alkylidene complex (eq 1). The authors report here the preparation of living polyenes of moderate length and block copolymers containing polyene sequences by this method.

43095 Process for light-driven hydrocarbon oxidation at ambient temperatures. Shelnutt, J.A. To Dept. of Energy, Washington, DC (USA). USA Patent 4917784/A/. 17 Apr 1990. Filed date 26 Sep 1989. USA Patent Application 7-412,736. Int. Cl. B01J 19/08. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a photochemical reaction for the oxidation of hydrocarbons using molecular oxygen as the oxidant. It comprises: a reductive photoredox cycle that uses a tin(IV)- or antimony(V)-porphyrin photosensitizer generates the reducing equivalents required to activate oxygen. This artificial photosynthesis system drives a catalytic cycle, which mimics the cytochrome P_{450} reaction, to oxidize hydrocarbons. An iron (III)- or manganese (III)-porphyrin is used as the hydrocarbon-oxidation catalyst. Methylviologen can be used as a redox relay molecule to provide for electron-transfer from the reduced photosensitizer to the Fe or Mn porphyrin. The system is long-lived and may be used in photoinitiated spectroscopic studies of the reaction to determine reaction rates and intermediates.

4005 Photochemistry

Refer also to citation(s) 43023, 43028

43096 The effects of axial ligation on the excited state dynamics of vanadyl tetraphenylporphyrin. Sparks, L.D. (Univ. of New Mexico, Albuquerque (USA)); Alden, R.G.; Ondrias, M.R.; Shelnutt, J.A. pp. 76 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC04-76DP00789. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Metalloporphyrins (MP) exhibit a variety of photodynamic behavior predicated upon the identity of the central metal. To gain insight into the initial photodynamics of MP sensitizers, the authors have probed the excited state conformation and electronic structure of vanadyl porphyrins in solution. The photodynamics of vanadyl tetraphenylporphyrin (VOTPP) were examined on a 10 ns timescale using transient resonance Raman and time-resolved luminescence spectroscopies.

43097 Photoionization studies in the $CF_3Br + O_2$ system. Walters, E.A. (Univ. of New Mexico, Albuquerque (USA)); Arneberg, D.L.; Clay, J.T.; Wall, M.H.; Grover, J.R. pp. 78 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC02-76CH00016. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Efficiency functions for photoionization and dissociative photoionization of CF_3Br and $CF_3Br \times O_2$ were measured using a photoionization mass spectrometer in which a molecular beam of target molecules and complexes, formed by a skimmed and recollimated free jet expansion of $CF_3Br + O_2$, intersected a tunable VUV beam from Brookhaven's 750 meV electron storage ring. The IP of CF_3Br was determined to be 11.50 ± 0.02 eV and the AP of CF_3^+ from CF_3Br is 12.0 ± 0.1 eV.

43098 The unimolecular triple dissociation of glyoxal: Transition-state structures optimized by configuration interaction and coupled cluster methods. Scuseria, G.E. (Univ. of Georgia, Athens (USA)); Schaefer, H.F. III. *Journal of the American Chemical Society (USA),* 111(20): 7761-7765 (27 Nov 1989).

Several high-level ab initio theoretical methods have been used to investigate the proposed (1980) triple whammy mechanism for the unimolecular dissociation of glyoxal. Basis sets of double zeta plus polarization (DZ + P) and triple zeta plus double polarization (TZ + 2P) quality have been used in connection with CISD, CCSD, and CCSDT-1 theoretical methods. The theoretical studies show unambiguously that the triple dissociation mechanism is operative under conditions used in the laboratory to investigate glyoxal photochemistry. Also confirmed, contrary to existing experiments, is the

early (1975) theoretical prediction of Dykstra that the C-C single bond distance of cis-glyoxal is longer than for trans-glyoxal. Vibrational frequencies for both cis- and trans-glyoxal are predicted and show good qualitative agreement with existing experimental data.

43099 Vibrational study of multiply metal-metal bonded ruthenium porphyrin dimers. Tait, C.D. (Los Alamos National Lab., NM (USA)); Sattelberger, A.P.; Woodruff, W.H.; Gerner, J.M.; Collman, J.P. *Journal of the American Chemical Society (USA)*, 111(20): 7806-7811 (27 Nov 1989).

The resonance Raman scattering (RR) and infrared absorption (IR) spectra of the $([Ru(OEP)]_2)^{n+}$ complexes (OEP = 2,3,7,8,12,13,17,18-octaethylporphyrin dianion; n = 0, 1,2; Ru-Ru bond order = 2.0, 2.5, 3.0) have been investigated. Resonance Raman studies revealed the Ru-Ru stretch to increase in frequency upon oxidation [285 cm^{-1} (n = 0), 301 cm^{-1} (n = 1), and 310 cm^{-1} (n = 2)], consistent with the removal of electrons from π^* metal-metal antibonding orbitals. The porphyrin-centered vibrational modes (both RR and IR active) for the complexes are essentially independent of oxidation state and very similar to those found for the monomeric complex Ru(OEP)(CO)(L). These data are likewise consistent with oxidation of metal-metal antibonding electrons. Correlations between the RR frequencies and empirical structural parameters for the complexes (Ru-Ru and Ru-N bond distances) are made and compared to the X-ray structure previously determined for the neutral species.

43100 Synthesis and photoactivity of chemically asymmetric polymeric porphyrin films made by interfacial polymerization. Wamser, C.C. (Portland State Univ., OR (USA)); Bard, R.R.; Senthilathipan, V.; Anderson, V.C.; Yates, J.A.; Ransdell, R.A.; Golbeck, J.H.; Sandberg, J.J.; Clarke, S.E.; Lonsdale, H.K.; Rayfield, G.W.; Friesen, D.T.; Lorenz, D.A.; Stangle, G.C.; van Eikeren *Journal of the American Chemical Society (USA)*, 111(22): 8485-8491 (25 Oct 1989).

Thin polymeric porphyrin films have been prepared by interfacial polymerization of a pair of reactive comonomers, one or both of which are derivatized tetraphenylporphyrins. Combinations that have successfully yielded polymeric films include the following: tetrakis(4-aminophenyl)porphyrin (TAPP) in DMSO with tetrakis[4-(chlorocarbonyl)phenyl]porphyrin (TCCPP) in ethyl acetate, various aliphatic diamines in water with TCCPP in chloroform, various aliphatic diacyl chlorides in hexane with TAPP in DMSO, tetrakis(4-hydroxyphenyl)porphyrin (THPP) in aqueous base with TCCPP in chloroform, and ZnTHPP in aqueous base with CuTCCPP in chloroform. The films display a unique chemical asymmetry, in the sense that opposite surfaces of the films show distinctive differences in the concentration and type of functional groups that are present, demonstrated by x-ray photoelectron spectroscopy (XPS) and by contact angle studies. When placed between identical semi-transparent electrodes and irradiated with either broad-band light or a pulsed laser, these films develop directional photopotentials, whereby the film surface that was prepared in contact with the TCCPP solution (the acid surface) develops a more negative potential than the opposite (amine or hydroxyl) surface.

4006 Radiation Chemistry

Refer also to citation(s) 43036

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 42551, 43042, 43326, 43327, 43328, 43329, 43429, 43475, 43476, 43477

43101 American Chemical Society, Division of Nuclear Chemistry and Technology. 22p. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Separate abstracts were prepared for 65 papers of this conference.

43102 An FTIR study of the atmospheric hydrolysis of UF_6. Angel, E.C. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); Armstrong, D.P.; Bostick, W.D.; Jarabek, R.J.; Pickrell, P.W.; Fletcher, W.H. pp. 8, Paper NUCL 23 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The reaction of uranium hexafluoride and water is a seemingly simple one as represented by: $UF_6 + 2H_2O \rightarrow UO_2F_2 + 4HF$. The handling and processing of UF_6 is accompanied by the potential for a reaction with water, usually as airborne moisture, and the subsequent risk of releasing airborne, particulate UO_2F_2 and gaseous hydrogen fluoride. The authors have studied this reaction under the simulated conditions of a release of UF_6, whereby hot, pressurized UF_6 gas is suddenly released into ambient air. The release experiment simulates, on a small scale, the accidental mixing of UF_6 gas with the atmosphere in the absence of wind currents. The data obtained using FTIR spectroscopy have provided information which permits a much better understanding of the behavior of the evolved hydrogen fluoride, the residual water vapor, the airborne, particulate UO_2F_2 and their relation to each other.

43103 Isotope dilution: A pressing problem in catalytic tritiations and tritiodehalogenations. Saljoughian, M. (Lawrence Berkeley lab., CA (USA)); Williams, P.G.; Morimoto, H. pp. 10, Paper NUCL 29 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The dilution of specific activity in tritiation and tritiodehalogenation reactions is a pressing problem in tritiation chemistry. The source and mechanism of this dilution has never been clearly outlined, nor have methods for overcoming the problem been studied in detail. The authors preliminary studies with a diaminobutyne precursor have strongly suggested that adsorbed hydrogen on the catalyst is one source of extra hydrogen and needs immediate investigation. The diaminobutyne is ideal for their preliminary study, since its proton NMR spectrum contains only two multiplets: 1,4-CH_2's at 2.95 ppm, and 2,3-CH_2's at 1.6 ppm. In the experiments to date, the dilution has been approximately 25%, and specific activity measurements of tritiated materials by liquid scintillation counting techniques agree with calculations from the NMR data. Their data indicate that the major sources of hydrogen are the catalyst and glassware. The results of a systematic study of relevant parameters will be discussed.

43104 Searches for massive neutrinos and their astrophysical implications. Sur, B. (Lawrence Berkeley Lab., CA (USA)). pp. 11-12, Paper NUCL 33 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC03-76SF00098. (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Prompted by results from the USSR and the ^{37}Cl solar neutrino experiment, new ^{3}H and terrestrial oscillation experiments in the last decade have continually improved the limits on the mass of the neutrino. In an effort to identify very low energy electron capture candidates to determine neutrino masses in the eV range, the authors have measured the Q-value for K-electron capture in ^{237}Pu to the 103-keV level in ^{237}Np to be -1.1 ± 1.2 keV. The recent resighting of the 17-keV neutrino has led them to mount two experiments. In one, the authors reexamine the end-point of the internal bremmstrahlung spectrum of ^{55}Fe with very good statistics and a well understood spectrometer. In the second, the authors examine the β spectrum from a ^{14}C doped Ge detector. Results from these experiments will be presented.

43105 In-beam spectroscopy and GE detectors: Twenty-five years of discovery and excitement. Diamond, R.M. (Lawrence Berkeley Lab., CA (USA)). pp. 12-13, Paper NUCL 37 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The founding of the Nuclear Chemistry and Technology Division twenty-five years ago came within a couple of years of two of the most important developments of modern nuclear spectroscopy, namely, the start of in-beam nuclear spectroscopy and the invention

of germanium (Ge) γ-ray detectors. They are still the foundations of present-day γ-ray spectroscopy, and have contributed to a number of discoveries, some of which will be discussed. And with the development of the large Compton-suppressed Ge arrays, present-day studies rank with the most exciting periods of the past twenty-five years, as, for example, the recent discoveries of superdeformed bands in the rare-earth and mercury regions.

43106 25 years of nuclear reaction studies - New accelerators, new experiments, new theories. Kaufman, S. (Argonne National Lab., IL (USA)). pp. 13, Paper NUCL 38 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract W-31-109-ENG-38. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Looking back over the last 25 years of nuclear reaction studies, one is struck by the ways that the experimental results have stimulated development of new theories and vice versa, as well as how the need for a wide range of projectiles and energies to test the theories resulted in construction of new accelerators and new experimental techniques. Examples are the discovery of fission shape isomers and the calculation of potential energy surfaces of nuclei, the role of high angular momentum and the availability of energetic heavy-ion beams, and the concept of multi-fragmentation and development of multi-detector arrays. In addition to discussing such notable examples, the author will describe the progress in their understanding of how complex nuclei interact during collisions, point out some of the open questions, and outline future prospects.

43107 The heaviest elements: Past, present and future. Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). pp. 13, Paper NUCL 39 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract AC03-76SF00098. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The region referred to be the designation heaviest elements has been a moving target ever since the production and the first identification of neptunium in 1940. The heaviest elements rapidly got heavier and, when their ACS Division of Nuclear Chemistry and Technology was formed in 1964, the elements through lawrencium (103) had been discovered. However, the chemical properties of nobelium and lawrencium had not yet been investigated. A program to produce transplutonium isotopes for studies of their chemical and nuclear properties and to provide targets for production of still heavier elements was initiated in the early 1960s. Since then, using targets in the lead region as well, the heaviest elements have been extended through element 109. A brief review of their progress in the past 25 years, the current state of their knowledge of the heaviest elements, and some predictions about what the heaviest elements may be 25 years from now will be given.

43108 Chemistry in nuclear technology. Wymer, R.G. (Oak Ridge National Lab., TN (USA)). pp. 15, Paper NUCL 45 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The past 25 years have not been so much a period of generation of new concepts and inventions in nuclear chemical technology as a period of extensions, improvements, and applications of known technology. In nuclear fuel cycle technology there have been advances toward more sophisticated and remotely operable equipment to carry out well-known processes. Transuranium element and radioisotope production processes carried out in hot cells have become routine plant operations. Non-aqueous fuel cycle process chemistry, which has been studied for years, is finally finding applications in liquid-metal reactor fuel reprocessing development at ANL, and AVLIS balance-of-plant process development at ORNL. The technology of radioactive waste management has assumed great importance in recent years.

43109 Gallium as a solar neutrino detector: Radiochemical aspects. Hahn, R.L. (Brookhaven National Lab., Upton, NY (USA)). pp. 19, Paper NUCL 62 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Observation of the low-energy neutrinos that are emitted in the primary energy-producing reaction in the sun, the p-p reaction, is an important facet of present-day solar neutrino research. No physical method currently is available for the detection of neutrinos with energies of hundreds of keV, but a suitable radiochemical detector does exist, Ga-71, with a threshold for neutrino capture of 233 keV. The key to the operation of a gallium detector is the ultrasensitive chemical isolation of the neutrino-capture product, Ge-71. The importance of this radiochemistry, which was developed over a period of many years, is often glossed over in discussions of solar neutrino measurements, because of the potentially great significance of the discovery of new neutrino properties. In this talk, some highlights of this chemistry will be discussed, including recent studies of effects of hot-atom chemistry or reactions with impurities.

43110 Ultrasensitive isotope analysis by photon burst mass spectrometry. Fairbank, W.M. Jr. (Colorado State Univ., Fort Collins (USA)); LaBelle, R.D.; Pan, X.J.; Chamberlin, E.P.; Keller, R.A.; Miller, C.M.; Fearey, B.L. pp. 21, Paper NUCL 70 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

A new technique for measuring large isotope ratios called Photon Burst Mass Spectrometry (PBMS) is being developed in their laboratories. PBMS combines the sensitivity and selectivity of laser atom counting by the photon burst method with the high throughput of a magnetic mass spectrometer. It is projected that isotope ratios in the 10^{11} to 10^{15} range, of interest in dating, tracer and analytical applications of radioisotopes, can be measured with this method. Results to date of demonstration experiments with magnesium and krypton isotopes will be reported.

43111 Collinear fast beam laser spectroscopy of stable and reactor produced unstable isotopes. Schuessler, H.A. (Texas A and M Univ., College Station (USA)); Buchinger, F. pp. 21-22, Paper NUCL 71 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Collinear fast beam laser spectroscopy can provide both Doppler-free resolution and ultrahigh sensitivity for studying the minute amounts of short-lived isotopes which are produced on-line. This paper reports on a series of experiments which were carried out at the High Flux Beam Reactor at Brookhaven National Laboratory using the on-line mass separator TRISTAN. The neutron-rich isotopes of the short-lived Ba(139-142), Ba(144) and the stable reference isotope Ba(138) as well as the short-lived Kr(88) and Kr(90) isotopes were produced by fission induced in a U(235) target located in a neutron flux of 2×10^{10} neutrons/cm^{2}sec. Hyperfine splittings and isotope shifts were measured. The changes in the nuclear charge radii of the short-lived neutron rich isotopes were evaluated and will be presented together with the analogous information for the stable isotopes.

43112 Determination of regulatory organic compounds in radioactive waste samples. Semivolatile organics in aqueous liquids. Tomkins, B.A. (Oak Ridge National Lab., TN (USA)); Caton, J.E. Jr.; Fleming, G.S.; Garcia, M.E.; Harmon, S.H.; Schenley, R.L.; Treese, C.A.; Griest, W.H. *Analytical Chemistry (Washington) (USA),* 62(3): 253-257 (1 Feb 1990). DOE Contract AC05-84OR21400.

The regulatory semivolatile organic compounds present in radioactive aqueous waste samples are extracted and concentrated in a small-scale version of a standard EPA procedure normally used for ground waters. Decontamination is sufficient to permit analysis of the extract in a conventional gas chromatography/mass spectrometry laboratory. The performance of the modified procedure, based on surrogate standards, matrix spikes and matrix spike duplicates, and blanks, is comparable to that of the standard

method. The modified procedure was applied to a variety of aqueous radioactive waste tank samples. Only 12 of the EPA Appendix VIII compounds were present, and none in concentrations exceeding the reporting limit (500 or 2,500 μg/L). The most common semivolatile present was tributyl phosphate, an organic extractant commonly used in radiochemical processing, at 2,000-30,000 μg/L.

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 42342, 42913, 43059, 43082, 43089

43113 (N–90-21842) **Detailed mechanism for oxidation of benzene.** Bittker, D.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. May 1990. 32p. (NASA-TM–102443;E–5224;NAS–1.15:102443). Source: NTIS, PC A03/MF A01.

A detailed mechanism for the oxidation of benzene is presented and used to compute experimentally obtained concentration profiles and ignition delay times over a wide range of equivalence ratio and temperature. The computed results agree qualitatively with all the experimental trends. Quantitative agreement is obtained with several of the composition profiles and for the temperature dependence of the ignition delay times. There are indications, however, that some important reactions are as yet undiscovered in this mechanism. Recent literature expressions have been used for the rate coefficients of most important reactions, except for some involving phenol. The discrepancy between the phenol pyrolysis rate coefficient used in this work and a recent literature expression remains to be explained.

43114 (N–90-22022) **Saturated fluorescence measurements of the hydroxyl radical in laminar high-pressure flames. Final report.** Carter, C.D.; King, G.B.; Laurendeau, N.M. Purdue Univ., Lafayette, IN (USA). Feb 1990. 222p. (NASA-CR–185218;NAS–1.26:185218). Source: NTIS, PC A10/MF A02.

The efficacy of laser saturated fluorescence (LSF) for OH concentration measurements in high pressure flames was studied theoretically and experimentally. Using a numerical model describing the interaction of hydroxyl with nonuniform laser excitation, the effect of pressure on the validity of the balanced cross-rate model was studied along with the sensitivity of the depopulation of the laser-coupled levels to the ratio of rate coefficients describing: (1) electronic quenching to (sup 2) Sigma (+) (v double prime greater than 0), and (2) vibrational relaxation from v double prime greater than 0 to v double prime = 0. At sufficiently high pressures and near-saturated conditions, the total population of the laser-coupled levels reaches an asymptotic value, which is insensitive to the degree of saturation. When the ratio of electronic quenching to vibrational relaxation is small and the rate of coefficients for rotational transfer in the ground and excited electronic states are nearly the same, the balanced cross-rate model remains a good approximation for all pressures. When the above ratio is large, depopulation of the laser-coupled levels becomes significant at high pressures, and thus the balanced cross-rate model no longer holds. A combustion facility for operation up to 20 atm was developed to allow LSF measurements of OH in high pressure flames. Using this facility, partial saturation in laminar high pressure (less than or equal to 12.3 atm) C2H6/O2/N2 flames was achieved. To evaluate the limits of the balanced cross-rate model, absorption and calibrated LSF measurements at 3.1 and 6.1 atm were compared. The fluorescence voltages were calibrated with absorption measurements in an atmospheric flame and corrected for their finite sensitivity to quenching.

43115 (UCRL-JC–103246) **Shock dynamics in the sub-nanometer femtosecond domain.** Karo, A.M. (Lawrence Livermore National Lab., CA (USA)); DeBoni, T.M.; Hardy, J.R.; Weiss, G.A. Lawrence Livermore National Lab., CA (USA). Apr 1990. 20p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-9004234–1: 1990 SANIBEL symposia, St. Augustine, FL (USA), Apr 1990). Order Number DE90014390. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

New experimental techniques combined with computer molecular dynamics simulations of increasing complexity are beginning to permit a detailed examination of the initial steps in the complex chemistry describing the high-temperature, high-pressure regime associated with combustion and detonation as well as processes that may be involved in shock-induced chemistry. We present the results of several simulations that describe the generation of moderately strong shocks and their interaction with molecules embedded in weakly-bound clusters, with material defects such as microscopic voids, and with molecular species placed in the neighborhood of such defects. 21 refs., 5 figs., 2 tabs.

42 ENGINEERING

43116 (UCRL–53868-89) **Engineering Research and Development: Thrust area report FY 89.** Lafranchi, E.; Genin, M.; Adye, P.; Canada, J.; Clements, W.; Gordon, K.; Highstone, H.; Kotowski, M.; Sceales, D. (eds.). Lawrence Livermore National Lab., CA (USA). Jun 1990. 314p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014728. Source: NTIS, PC A14/MF A01 - OSTI; GPO Dep.

The mission of the Engineering Research Program is to develop the people and technology needed to support current and future Laboratory programs. To accomplish this mission Engineering Research has two important goals – to identify key technology areas important to the Laboratory and to conduct high quality research and development. To help focus our efforts in achieving these goals we identify key technologies called thrust areas and select technical leaders for each area. The thrust areas are an integrated Engineering activity and, rather than being primarily discipline based they are staffed by researchers from EE, ME and other Laboratory organizations as appropriate. The thrust area leader is responsible for carrying out the development work that follows from the Research Program so that the results of the research can be applied as early as possible to the needs of the programs. This annual report, organized by thrust area, describes research and development activities conducted within the Engineering Research Program for fiscal year 1989.

4202 Facilities, Equipment, and Techniques

Refer also to citation(s) 42403, 42404, 42405, 42564, 42585, 42586, 42587, 42588, 42589, 42590, 42591, 42592, 42593, 42594, 42595, 42596, 42597, 42598, 42599, 42600, 42601, 42685, 43137

43117 (CDTN-DETS-PD–001/84) **Preliminary project of installation for separation tubes tests-ITTS.** Rocha, Z. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 16 Jan 1984. 43p. (In Portuguese). Order Number DE90635420. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A consolidation of actual ideas about installation, entitled "Installation to separation tubes tests-ITTS", expected to CDTN is presented. The project bases, the testing to be realized, the procedures to be obeyed during the operation, the components and the space required by installation and auxiliary equipments, the presumable origin of components (nacional and international), including a preliminary list of building and operation costs are described. (author).

43118 (CEA-CONF–10047) **Dilution refrigerator with no liquid helium supply.** Pari, P. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique. 1989. 9p. (CONF-890701–: International cryogenic materials conference, Los Angeles, CA (USA), 24-28 Jul 1989). Order Number DE90511932. Source: NTIS (US Sales Only), PC A02/MF A01.

We have designed and constructed a ^{3}He-^{4}He dilution refrigerator which does not require the use of liquid nitrogen or liquid helium dewars. The ^{3}He-^{4}He mixture, compressed to 10^5Pa, is first precooled to near 12K in a closed-cycle regenerative refrigerator (AIR PRODUCTS DE202) then cooled to near 4.2K by a separate ^{4}He compression stage. The mixture then undergoes a series of expansions and coolings in a heat exchanger which takes the temperature to below 0.1K. The limiting steady state temperature is 70mK and the total cool down time is 20 hours. This system

is a test prototype which has enabled a number of problems to be analysed. It is equipped with a very basic dilution stage operating at 70mK. The chief aim was to verify the good working order of the ensemble. A new apparatus is being constructed which will reach near 20mK in less than 12 hours.

43119 (CONF-9007134–1) **A hardware/software environment to support R & D in intelligent machines and mobile robotic systems.** Mann, R.C. Oak Ridge National Lab., TN (USA). [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (CESAR–90/30). From DARPA workshop on distributed intelligent control systems; Pacifica, CA (USA); 17-19 Jul 1990. Order Number DE90014458. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Center for Engineering Systems Advanced Research (CESAR) serves as a focal point at the Oak Ridge National Laboratory (ORNL) for basic and applied research in intelligent machines. R&D at CESAR addresses issues related to autonomous systems, unstructured (i.e. incompletely known) operational environments, and multiple performing agents. Two mobile robot prototypes (HERMIES-IIB and HERMIES-III) are being used to test new developments in several robot component technologies. This paper briefly introduces the computing environment at CESAR which includes three hypercube concurrent computers (two on-board the mobile robots), a graphics workstation, VAX, and multiple VME-based systems (several on-board the mobile robots). The current software environment at CESAR is intended to satisfy several goals, e.g.: code portability, re-usability in different experimental scenarios, modularity, concurrent computer hardware transparent to applications programmer, future support for multiple mobile robots, support human-machine interface modules, and support for integration of software from other, geographically disparate laboratories with different hardware set-ups. 6 refs., 1 fig.

43120 (DOE/CE/15441–T2) **[Method and apparatus for applying metal cladding].** Copperlok, Inc., Hatboro, PA (USA). 24 Jul 1990. 24p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE15441. Order Number DE90014404. Source: NTIS, PC A03/MF A01 - OSTI.

This is a collection of letters and documents concerning an electric are metallizing technology to apply protective coating to a variety of materials to prevent corrosion and fouling. 23 figs. (FSD)

43121 (KCP–613-4276) **Quality function deployment as a mechanism for process characterization and control: Final report.** Gillespie, L.K. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1990. 86p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE90014755. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This study was initiated to determine how well quality function deployment (QFD) was suited for process characterization. The process chosen on which to test QFD was the mechanical process of flat lapping (flat sanding) metal parts to a specified flatness or finish. This is the first use of QFD at this facility. It is the first example the authors have seen of its use for generic process characterization. It is normally used to define product needs. 13 refs., 16 figs., 5 tabs.

43122 Impact analysis of shipping casks. Pfeiffer, P.A. (Argonne National Lab., Argonne, IL (US)); Kennedy, J.M. pp. 109-114 of Transactions of the 10th international conference on structural mechanics in reactor technology: Volume J. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This paper describes how simpler two- and three-dimensional models can be used to provide an intermediate level of detail between full three dimensional finite element calculations and hand calculation. Three free drop scenarios are analyzed to assess the integrity of the cask when subjected to large bending and axial stresses. These three drop scenarios are: a thirty foot axial drop on either end, a thirty foot oblique angel drop with the cask having several different orientations from the vertical with impact on the top end cask corner, and a thirty foot side drop with simultaneous impact on one of the lifting trunnions and the bottom end. Prevention of damage hinges on the strength of the various components that comprises the cask. The predicted levels of deformation and stresses in the cask are used to assess the potential damage level.

43123 Monodisperse aerosol generator. Ortiz, L.W.; Soderholm, S.C. To Dept. of Energy, Washington, DC (USA). USA Patent 4917830/A/. 17 Apr 1990. Filed date 19 Sep 1988. USA Patent Application 7-246,062. Int. Cl. B01F 5/02. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an aerosol generator capable of producing a monodisperse aerosol within narrow limits. It comprises: utilizing an aqueous solution capable of providing a high population of seed nuclei and an organic solution having a low vapor pressure. The two solutions are cold nebulized, mixed, vaporized, and cooled. During cooling, particles of the organic vapor condense onto the excess seed nuclei, and grow to a uniform particle size.

43124 Quick-sealing design for radiological containment. Rampolia, D.S.; Speer, E. To Dept. of Energy, Washington, DC. USA Patent 4914793/A/. 10 Apr 1990. Filed date 9 Nov 1987. USA Patent Application 7-118,084. Int. Cl. A44B 19/32. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a quick-sealing assembly and method for forming an adhesive seal on opposite sides of a mechanical seal for a flexible containment bag of the type used for working with radioactively contaminated objects. The assembly includes an elongated mechanical fastener having opposing engaging members affixed at a predetermined distance from each of the elongated edges, with an adhesive layer formed between the mechanical fastener and the elongated edge such that upon engagement of the mechanical fastener and adhesive layers to opposing containment fabric, a neat triple hermetic seal is formed.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 42736, 42781

43125 (LUTMDN-TMVK–3135-1-45-1990) **Influence of the inlet values of turbulent quantities on predictions of the mean velocity field of flow in calculations with the k-ε-turbulence model.** Halldin, C. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Jan 1990. 44p. (In Swedish). Order Number DE90512595. Source: NTIS (US Sales Only), PC A03/MF A01.

The report presents results of calculations of the mean velocity fields of flow in water flow through a sudden expansion. The study aims at investigating the inlet values of turbulent quantities. Comparisons are made between experimental data from flow cases with Reynolds numbers between 30000 and 100000, and swirl numbers between 0 and 1.23. The calculations are made by means of the computer program FLUENT, where the k-ε turbulence model is used for studying the variation of the inlet k- and ε-values respectively. The Algebraic-Stress-Model (ASM) of the program is utilized as well for comparative calculations. The investigation demonstrates that variations in both k and ε may result in great changes in predicted mean velocity fields of flow. A tendency of these changes being more evident at higher swirl numbers is noticed. Both the k-ε and the ASM model give considerably better results without rotation (swirl number=0) than with rotation (swirl number 0.17-1.23). This is particularly true for the axial mean velocity in the centre. By rotating flow the predictions may be improved by a careful choice of inlet values of k and ε. (10 refs.).

43126 (RISO-M–2818) **Large scale laboratory experiments with two-phase flow in pipes.** Oil/Gas Two-Phase Flow, Report no. 6. Christiansen, L. (Risoe National Lab., Roskilde (Denmark). Energy Technology); Gottlieb, L. Risoe National Lab., Roskilde (Denmark). Energy Technology; Lic Consult Raadgivende Ingenioerer A/S, Copenhagen (Denmark). Apr 1990. 40p. Contract EM-1313/88-13. Order Number DE90509410. Source: NTIS (US Sales Only), PC A03/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

EFP-88.

An experimental and theoretical study of the transition between stratified flow and slug flow in two-phase flow has been carried out as a joint project between Risoe National Laboratory, LICconsult

Consulting Engineers Ltd. and the Institute of Hydrodynamics and Hydraulic Engineering at the Technical University of Denmark. The test rig is a partly transparent tube, 50 meters long with an inner diameter of 90 mm. All experiments have been performed with air/water mixtures at horizontal flow. Wave heights have been measured using resistance wires mounted vertically across the tube. The measurements were recorded digitally with a sampling rate of 38 readings pr. sec. and the physical shape of the waves in the transition region has been thoroughly investigated. A physically based mathematical model for the transition between stratified flow and periodic slug flow has been established and verified against experiments. (author) 4 tabs., 16 ills., 6 refs.

4205 Materials Testing

Refer also to citation(s) 42556, 42557, 42568, 42960, 42961, 43017

43127 (CDTN-DETS-PD–039/81) **Aid to program elaboration in corrosion area to be done between CDTN (Centro de Desenvolvimento da Tecnologia Nuclear) and NUCLEN (Nuclebras Engenharia).** Moreira, P.A.L.D. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 11 Dec 1981. 41p. (In Portuguese). Order Number DE90635468. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Directives to stations construction that allows corrosion test in totally and partially sea water immersed materials exposed to a marine atmosphere are presented. (C.M.).

43128 (FhG-IzfP–870406-TW) **Nondestructive evaluation of residual lifetime by means of ultrasound. Final report.** Willems, H. Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Mar 1987. 87p. (In German). Contract COST 501 Project D9;BMFT/KFA 03ZYK032;BMFT 102 253. Order Number DE90512995. Source: NTIS (US Sales Only), PC A05/MF A01.

The influence of fatigue loading and creep loading, respectively, on the ultrasonic propagation has been investigated. Ultrasonic velocity proved to be the most sensitive measuring quantity. Concerning creep loading thermal ageing as well as plastic deformation and creep damage, i.e. micropores and microcracks, produced measurable velocity changes. Whereas the influence of plastic deformation becomes negligible under service conditions, the influence of thermal ageing can be separated from the damage effect by measuring velocity relative to the thermally aged state. For the investigated Alloy 800H damage becomes detectable during the transition range from secondary to tertiary creep. Additionally, creep damage in a service exposed 14 MoV 63 steel has been characterized in agreement with destructive measurements. Assuming a measuring accuracy of 10^{-3} for relative velocity measurements pore concentrations (volume content) down to $1{,}5x10^{-3}$ can be measured. Practical applications concerning the early detection of creep damage at the micropore stage seem to be possible. In the case of fatigue damage ultrasonic measurements are less appropriate if the damage occurs only at the surface region within a depth that is small compared to the ultrasonic wavelength. This usually holds for damage due to symmetric fatigue loading. For imaging of surface-near damage acoustic microscopy techniques have been applied successfully. (orig./MM).

43129 (LA-UR–90-2410) **Application of safeguards technology in DOE's environmental restoration program.** Eccleston, G.W.; Baker, M.P.; Hansen, W.R.; Lucas, M.C.; Markin, J.T.; Phillips, J.R. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106–42: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014908. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

During the last two decades, the Department of Energy's Office of Safeguards and Security (DOE/OSS) has supported the research and development of safeguards systems analysis methodologies and nondestructive assay (NDS) technology for characterizing, monitoring, and accounting nuclear materials. This paper discusses methodologies and NDA instrumentation developed by the DOE/OSS program that could be applied in the Environmental Restoration Program. NDA instrumentation could be used for field measurements during site characterization and to monitor nuclear materials, heavy metals, and other hazardous materials during site remediation. Systems methodologies can minimize the expenditure of resources and help specify appropriate combinations of NDA instrumentation and chemical analyses to characterize a variety of materials quickly and reduce personnel exposure in hazardous environments. A training program is available to teach fundamental and advanced principles and approaches to characterize and quantify nuclear materials properly and to organize and analyze measurement information for decision making. The ability to characterize the overall volume and distribution of materials at a waste site is difficult because of the inhomogeneous distribution of materials, the requirement for extreme sensitivity, and the lack of resources to collect and chemically analyze a sufficient number of samples. Using a systems study approach based on statistical sampling, the resources necessary to characterize a site can be enhanced by appropriately combining in situ and field NDA measurements with laboratory analyses. 35 refs., 1 figs., 2 tabs.

4210 Combustion Systems

43130 (N–90-21165) **Hydrocarbon-fuel/combustion-chamber-liner materials compatibility. Interim final report, 7 November 1986-31 October 1989.** Gage, M.L. Aerojet Technical Systems Co., Sacramento, CA (USA). Apr 1990. 249p. (NASA-CR–185203;NAS–1.26:185203;KBQ-FR–1). Source: NTIS, PC A11/MF A02.

Results of material compatibility experiments using hydrocarbon fuels in contact with copper-based combustion chamber liner materials are presented. Mil-Spec RP-1, n- dodecane, propane, and methane fuels were tested in contact with OFHC, NASA-Z, and ZrCu coppers. Two distinct test methods were employed. Static tests, in which copper coupons were exposed to fuel for long durations at constant temperature and pressure, provided compatibility data in a precisely controlled environment. Dynamic tests, using the Aerojet Carbothermal Test Facility, provided fuel and copper compatibility data under realistic booster engine service conditions. Tests were conducted using very pure grades of each fuel and fuels to which a contaminant, e.g., ethylene or methyl mercaptan, was added to define the role played by fuel impurities. Conclusions are reached as to degradation mechanisms and effects, methods for the elimination of these mechanisms, selection of copper alloy combustion chamber liners, and hydrocarbon fuel purchase specifications.

4220 Mining and Underground Engineering

43131 **Brittle fracture phenomena: An hypothesis.** Walton, O.R. (Lawrence Livermore National Lab., CA (USA)); Britton, K. pp. 16-29 of Proceedings of the second international symposium on rock fragmentation by blasting. Fourney, W.L.; Dick, R.D. Society for Experimental Mechanics, Bethel, CT (USA) (1987). DOE Contract W-7405-ENG-48. (CONF-870867–: 2. international symposium on rock fragmentation by blasting, Keystone, CO (USA), 23-26 Aug 1987).

This paper proposes that volumetric dilation is a fundamental requirement for brittle fracture involving shear. Such dilation involves or is expressed as zonal overpressures. The overpressured zones radiate particle motions which are significant to or dominate seismic radiation from blasting. The overpressures are significant to and may dominate the energetics of blastings. Outstanding problems and gaps in knowledge regarding fragmentation are discussed. It is argued that there is a common missing factor, dilatancy. Supporting evidence is presented from soils and rock mechanics, blasting experimental data and blasting experience. Computer modeling of fragmentation is discussed and the necessity for the inclusion of dilatancy established. Implications are discussed and a test of the hypothesis proposed.

4230 Marine Engineering

Refer also to citation(s) 42365, 43120

43132 (CONF-9006247–2) **Composite hull for full-ocean depth.** Garvey, R.E.; Hawkes, G.S. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 4. annual thick composites in compression workshop; Knoxville, TN (USA); 26-28 Jun 1990. Order Number DE90014446. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A lightweight and economical modular design concept for a manned submersible is proposed to give two passengers repeated access to the deepest parts of the ocean in a safe, comfortable, and efficient manner. This versatile craft will allow work and exploration to be accomplished at moderate to maximum depths without any compromise in terms of capabilities or operating cost. Its design follows the experience acquired from the numerous existing "minimum volume" pressure hull submersible, and represents a radical departure from conventional designs. This paper addresses issues of gaining effective, safe working access for full ocean depth. Cylindrical composite hulls have the potential to achieve positive buoyancy sufficient to carry personnel and equipment swiftly back to the surface after completing exploration of the deepest ocean. Buoyancy for a submersible is similar to lift for an airplane, except that without lift, the airplane remains on the surface, but without buoyancy, the submersible never returns to the surface. There are two means of achieving buoyancy. The traditional method used to steel, titanium, or aluminium alloy deep-ocean vehicles is to add a very large buoy to compensate for the negative buoyancy of the hull. The alternate method is for the hull to displace more than its weight in water. This requires at least twice compression strength per unit mass of hull than steel, titanium, or aluminum alloys can provide. Properly constructed organic-matrix composites are light and strong enough to form a dry, 1-atm cabin with buoyancy to carry research staff and equipment to any depth in the ocean. Three different composite hull configurations are presented. Each is capable of serving as a cabin for a two-person crew. None would displace more than 4 tons of seawater. 30 refs., 3 figs., 1 tab.

4250 Power Cycles

Refer also to citation(s) 42636, 42816, 43137

43133 (N–90-22606) **Programmatic status of NASA's CSTI high capacity power stirling space power converter program.** Dudenhoefer, J.E. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1990. 9p. (NASA-TM–103142;E–5494;NAS–1.15:103142;CONF-900801–: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Source: NTIS, PC A02/MF A01.

An overview is presented of the NASA Lewis Research Center Free-Piston Stirling Space Power Converter Technology Development Program. This work is being conducted under NASA's Civil Space Technology Initiative (CSTI). The goal of the CSTI High Capacity Power element is to develop the technology base needed to meet the long duration, high capacity power requirements for future NASA space initiatives. Efforts are focused upon increasing system thermal and electric energy conversion efficiency at least fivefold over current SP-100 technology, and on achieving systems that are compatible with space nuclear reactors. The status of test activities with the Space Power Research Engine (SPRE) is discussed. Design deficiencies are gradually being corrected and the power converter is now outputting 11.5 kWe at a temperature ratio of 2 (design output is 12.5 kWe). Detail designs were completed for the 1050 K Component Test Power Converter (CTPC). The success of these and future designs is dependent upon supporting research and technology efforts including heat pipes, gas bearings, superalloy joining technologies and high efficiency alternators. An update of progress in these technologies is provided.

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 42659, 42819, 42896, 42897, 42898, 42899, 42900, 42901, 42902, 42903, 42904, 42905, 42906, 42907, 42978, 42980, 43216, 43217, 43218, 43219, 43221, 43225, 43226, 43227, 43430, 43573, 43615

43134 (DOE/BP/34906–1) **Adjustable speed drive applications guidebook.** Szablya, H.M. (ed.) (Ebasco Services, Inc., Bellevue, WA (USA)); Kovarik, C.J.; Hassan, I.D.; Takisaki, G. Ebasco Services, Inc., Bellevue, WA (USA); EA-Mueller, Inc., Baltimore, MD (USA). Jan 1990. 101p. Sponsored by U.S. DOE Bonneville Power Administration. DOE Contract AC79-87BP34906. Order Number DE90014151. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Reducing motor speed to match process requirements saves energy and improves process control. This guidebook looks at a number of industrial applications and processes that can be improved and made more energy efficient by applying ASDs. It assists in determining suitable ASD applications in terms of technical and economic screening factors. It is intended for plant engineers, plant managers, and others concerned with better product quality and energy management in industrial processes. 5 refs., 51 figs., 7 tabs.

43135 (LA-UR–90-2294) **Three-dimensional simulations of the generation of one Angstrom radiation by a self-amplified spontaneous emission free-electron laser.** Goldstein, J.C.; Elliott, C.J.; Schmitt, M.J. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9004232–2: 1. Angstrom FEL workshop, Sag Harbor, NY (USA), 22-27 Apr 1990). Order Number DE90015032. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Three-dimensional numerical simulations of the generation of one Angstrom x-rays by a free-electron laser operating in the self-amplified spontaneous emission mode have been performed. Using model electron beam and wiggler parameters, we have investigated the length of wiggler needed to just avoid bandwidth broadening effects associated with gain saturation, and we have also obtained requirements for wiggler field errors to avoid significant loss of performance. 14 refs., 5 figs., 1 tab.

43136 (LBL–28544) **Low frequency magnetic resonance with a dc SQUID [Superconducting QUantum Interference Device].** Connor, C. Lawrence Berkeley Lab., CA (USA). Oct 1989. 136p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90013357. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Conventional NMR and NQR spectrometers use transistor-based detectors, which are responsive only to voltage. This forces the experimenter to convert the sample magnetization to a voltage, a process that is less efficient at low frequencies when the Faraday induction effect is used. However, the SQUID directly measures the magnetization, so there is no frequency dependent sensitivity to the sample magnetization. Of course, many other devices also measure magnetic field directly, but none has the low frequency sensitivity of the SQUID. Chapter 2 presents the theory required to extend conventional magnetic resonance to z-axis magnetic resonance, a form most efficient for the SQUID. The operating principles of the SQUID, as well as the techniques used to convert the SQUID response into a useful output voltage, are outlined in Chapter 3. The SQUID spectrometer constructed for these experiments is described in Chapter 4. Also in this chapter are a discussion of the design considerations for a SQUID spectrometer, and indications of the overall performance of our instrument. Experimental results on NQR and low frequency NMR are found in Chapters 5 and 6, respectively. 96 refs., 38 figs., 5 tabs.

43137 (LBL–28843) **The role of superconductor in reducing the refrigeration needed to cool the leads of a superconducting magnet.** Green, M.A. Lawrence Berkeley Lab., CA (USA). Apr 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-900423–2: 13. international cryogenic engineering conference (ICEC-13), Beijing (China), 24-27 Apr 1990). Order Number DE90014188. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The electrical lead represents a major heat load and a major user of refrigeration in a superconducting magnet system. It has been postulated that high $T_c$superconductor could be used to reduce the refrigeration required by the leads in a conventional superconducting magnet. Substantial refrigeration reductions appear possible using superconductor in conjunction with gas cooled leads

provided the gas is drawn from the refrigerator at a temperature just below T_c. Even with conventional superconductors, refrigeration reductions of a factor of two appear to be possible using this technique. 6 refs., 2 figs., 3 tabs.

43138 (N–90-22030) **Direct solar-pumped iodine laser amplifier. Final report, 1 March 1984-28 February 1990.** Han, K.S.; Hwang, I.H. Hampton Inst., VA (USA). Mar 1990. 17p. (NASA-CR–186442;NAS–1.26:186442). Source: NTIS, PC A03/MF A01.

The optimum conditions of a solar pumped iodine laser are found in this research for the case of a continuous wave operation and a pulsed operation. The optimum product of the pressure(p) inside the laser tube and the tube diameter(d) was pd=40 approx. 50 torr-cm on the contrary to the case of a high intensity flashlamp pumped iodine laser where the optimum value of the product is known to be pd=150 torr-cm. The pressure-diameter product is less than 1/3 of that of the high power iodine laser. During the research period, various laser materials were also studied for solar pumping. Among the laser materials, Nd:YAG is found to have the lowest laser threshold pumping intensity of about 200 solar constant. The Rhodamine 6G was also tested as the solar pumped laser material. The threshold pumping power was measured to be about 20,000 solar constant. The amplification experiment for a continuously pumped iodine laser amplifier was performed using Vortek solar simulator and the amplification factors were measured for single pass amplification and triple pass amplification of the 15 cm long amplifier tube. The amplification of 5 was obtained for the triple pass amplification.

43139 (N–90-22031) **Development of mid-infrared solid state lasers for spaceborne lidar. Final report, 13 April 1988-31 January 1990.** Whitney, D.A. Hampton Inst., VA (USA). Jan 1990. 51p. (NASA-CR–185095;NAS–1.26:185095). Source: NTIS, PC A04/MF A01.

Researchers investigated laser performance of Ho(3+):Tm(3+):Cr(3+):YAG crystals under both Cr:GSAG laser and flashlamp pumping. A flashlamp pumped Cr:GSAG laser was built to simulate high power quasi-CW laser diode pumping of a 2.1 micron holmium laser. The 2.1 micron output laser energy exceeded more than 14 mJ, the highest value reported to date under laser pumping near 785 nm. This was obtained in a pulse length of nearly 650 microns from a 3 x 3 mm Ho:Tm:Cr:YAG rod by using the flashlamp-pumped Cr:GSAG laser as a pumping source at the diode laser wavelength, 785 microns. In addition, Ho:Tm:Cr:YAG crystals with various Tm(3+) concentrations have been evaluated for flashlamp-pumped normal mode and Q-switched 2.1 micron laser operations under a wide variety of experimental conditions in order to understand internal dynamic processes among the ions and to determine an optimum lasing condition. An increase of the laser slope efficiency was observed with the increase of the Tm(3+) concentration from 2.5 atomic percent to 4.5 atomic percent. The thermal dependence of the laser performance was also investigated. Q-switched laser output energies corresponding to nearly 100 percent of the normal-mode laser energies were obtained in a strong single spike of 200 ns pulse length by optimizing the opening time of a lithium niobate Q-switch.

43140 (SAND–90-0415C) **Investigations into the use of dielectric coatings in magnetic switches.** Harjes, H.C.; Sharp, D.J.; Mann, G.A.; Morgan, F.A.; Yelton, W.G. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9006176–10: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90014331. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High reliability, high efficiency, long lifetime magnetic switches (saturable reactors) will be required in the high power pulse compression systems which are now being considered for use in several applications. One of the most critical components in a magnetic switch is its inter lamina insulation. In high speed (high magnetization rate) magnetic switches, the insulation requirements are severe and the thermal management of core losses is a serious design issue. In such a switch, the inter lamina voltage can approach 1000 V and, at present, dielectric films (such as Mylar, Polycarbonate, Kapton, etc.) are the only insulation options. These insulations, however, make the thermal management problem more difficult because they have low thermal conductivities and because substantial margins are required on the sides of the core. In addition, it is difficult to realize the normal holdoff strengths of thin films when they are wound with Metglas (the magnetic material of choice in most high speed switches) because the films can be degraded during the winding process by the rough Metglas surface. This paper reports the results of our investigations into the possibility of using conformal dielectric coatings as a viable insulation option in high speed magnetic switches. 10 refs., 8 figs., 1 tab.

43141 (SAND–90-1085C) **Minimizing frequency pulling of quartz oscillators due to power supply variations.** Wessendorf, K.O. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009220–1: 12. annual piezoelectric devices conference, Kansas City, MO (USA), 25-27 Sep 1990). Order Number DE90014566. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

When quartz controlled oscillators are required for use in applications demanding precision many factors will ultimately place limitations on the ability of the oscillator to remain at the desired frequency. These factors include temperature, resonator Q, pullability, radiation, output load variability, and the electronic components. This paper addresses the subject of frequency instability of oscillator circuits due to power supply voltage variations. In particular, the primary sources of this instability are described for a Pierce oscillator employing a bipolar transistor and design techniques are presented which minimize these frequency pulling effects. 4 refs., 17 figs.

43142 (UCRL–102850) **Modeling tape-wound magnetic switches.** Zentler, J.M. Lawrence Livermore National Lab., CA (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006176–11: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90015121. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An empirical ferromagnetic model developed by M. L. Hodgdon has been incorporated into the NET-2 Circuit Analysis Program to allow detailed simulation of magnetic modulators. The model is capable of representing rate dependency of the material B-H characteristics and internal losses. This tool has been used successfully to simulate non-uniform magnetization within magnetic switch cores during the switching process. Comparison is made with published experimental results on amorphous tape-wound cores subjected to 0.1 T/μsec and 1 T/μsec magnetization rates.

43143 (UCRL-JC–104125) **New resonantly photo-pumped x-ray laser schemes.** Nilsen, J. Lawrence Livermore National Lab., CA (USA). 14 Jun 1990. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9005253–1: International symposium on short wavelength lasers and their applications, Samarkand (USSR), 14-18 May 1990). Order Number DE90015044. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Over the last several years there has been tremendous progress in the development of x-ray lasers. However, only two pumping mechanisms have been used to create gain and produce laser output, these have been collisional excitation, in the case of the Ne-like and Ni-like lasers, and recombination, in the case of the H-like and Li-like lasers. Other mechanisms such as photoionization and resonant photo-pumping have been proposed as possible candidates to build to x-ray laser. However, the resonant photo-pumping mechanism has not yet been demonstrated in the soft x-ray region. The shortest wavelength at which significant gain has been measured using resonant photo-pumping is at 2163 Å in Be-like C. This paper presents several new laboratory x-ray laser schemes which show great promise based on resonant photo-pumping of Ne-like and Ni-like ions.

43144 **Applied superconductivity.** Wolsky, A.M. (Argonne National Lab., IL (USA)). 365p. Noyes Publications, Park Ridge, NJ (USA) (1989).

The impact of recent superconducting materials research is discussed, indicating research goals which appear realistic and, if reached, would enable diverse commercial applications of the new

materials. Topics covered include: Renewable sources for electricity generation, Generators, Transformers, AC transmission, and Superconducting magnetic energy storage.

43145 Variations with laser pulse duration of the thresholds at 350 nm and 1064 nm for bulk damage in crystals of KDP. Gonzales, R.P. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Staggs, M.C.; Singleton, M.F.; George, D.; Weinzapfel, C.L.; Weinzapfel, S. pp. 206-210 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). DOE Contract W-7405-ENG-48. (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

This paper reports five separate laser facilities used to measure 350-nm and 1064-nm thresholds for bulk damage in crystals of KDP. At 1064-nm, tests were made with single laser pulses having durations of 1, 9 and 25 ns and with 9-ns pulses incident at 10 Hz. At 350-nm test were made with single pulses having durations of 0.6, 5.0 and 25 ns and with 25-nm pulses incident at rates up to 50 Hz. Over the range from 0.6 to 25 ns, 350-nm thresholds increased by a factor of approximately 2, and 350-nm thresholds were almost independent of laser repetition rate. The 1064-nm thresholds increased by a factor of >3 as pulse duration increased from 1 to 25 ns. Laser hardening of thresholds was observed at both 350-nm and 1064-nm.

43146 Design study for the large helical device. Iiyoshi, A. (National Inst. for Fusion Science, Furo-cho Chikusa-ku, Nagoya 464-01 (JP)); Fujiwara, M.; Motjima, O.; Ohyabu, N.; Yamazaki, K. *Fusion Technology (USA)*, 17(1): 169-187 (Jan 1990).

The Large Helical Device (LHD) is a Heliotron/torsatron-type superconducting helical confinement fusion device. The design study is described. The goal of the LHD is to demonstrate high energy confinement and high beta in a helical device, which are necessary steps toward a helical reactor system.

43147 Experimental experience with a superconducting magnetic energy storage (SMES) device on line. Skiles, J.J. (Wisconsin Univ., Madison, WI (USA). Dept. of Electrical and Computer Engineering); Boom, R.W.; Kustom, R.L.; Helfrecht, D.J.; Lowe, B.J. *Proceedings of the American Power Conference (USA)*, 51: 478-483 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

Power conversion system interfaces and utility operation with a superconductive magnetic energy storage (SMES) system have been studied as part of a 18-year research program on SMES for utility applications. The small laboratory SMES system has been used for research on power electronics circuits for about six years. This paper summarizes the experience in on-line operation of the laboratory SMES system in studies of power conversion systems and operations typical of the manner an electric utility would use a full-size SMES unit.

43148 Extreme ultraviolet reflector. Newnam, B.E. To Dept. of Energy, Washington, DC (USA). USA Patent 4917447/A/. 17 Apr 1990. Filed date 6 Feb 1989. USA Patent Application 7-306,358. Int. Cl. G02B 17/00. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a multi-faceted mirror that forms a retroreflector for a resonator loop in a free electron laser (FEL) operating in the XUV (λ = 10–100 nm). The number of facets is determined by the angle-of-incidence needed to obtain total external reflectance (TER) from the facet surface and the angle through which the FEL beam is to be turned. Angles-of-incidence greater than the angle for TER may be used to increase the area of the beam incident on the surface and reduce energy absorption density. Suitable surface films having TER in the 10–100 nm range may be formed from a variety of materials, including Al, single-crystal Si, Ag, and Rh. One of the facets is formed as an off-axis conic section to collimate the output beam with minimum astigmatism.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 42816, 43432

4301 Design, Development, and Operation

Refer also to citation(s) 43442

43149 (BNL–44823) **Accelerator projects in the USA.** Samios, N.P. Brookhaven National Lab., Upton, NY (USA). [1990]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900348–12: 2. international industrial symposium on the super collider, Miami, FL (USA), 14-16 Mar 1990). Order Number DE90015088. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A review was presented of operating, planned and high energy accelerators under construction in the US. It was pointed out that the program is broad based, addressing a variety of frontiers and encompassing many of most fruitful projectiles, intensities, and energy ranges. The US program is also geographically diversified across the country in major research centers. The physics productivity over the past years has been excellent with a emphasis on the importance of sustaining the base program at least until the SSC is operating and possibly beyond. 9 figs.

43150 (CERN–90-01) **Concept for a lead-ion accelerating facility at CERN.** Billinge, R.; Boltezar, E.; Boussard, D.; Brouzet, E.; Cappi, R.; Raad, B. de; Doble, N.; Grafstroem, P.; Haseroth, H.; Hill, C.E.; Kissler, K.H.; Knott, J.; Linnecar, T.; Nitsch, F.; Poncet, A.; Raich, U.; Rasmussen, N.; Schoenauer, H.; Sherwood, T.R.; SiEuropean Organization for Nuclear Research, Geneva (Switzerland). 28 Feb 1990. 42p. Order Number DE90635424. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

After the successful acceleration of deuterons, alpha particles and in more recent years of oxygen and sulphur ions, interest arose for even heavier particles. This paper describes the problems associated with heavy ions. A proposal is made for a scenario which allows the CERN accelerators to cope with ions heavier than sulphur, e.g. lead. Discussed are the different options for the injector and the necessary upgrading for the circular machines. (orig.).

43151 (INPE–4958) **Beam collector and output window for a 35GHz, 100 KW gyrotron.** Barroso, J.J. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Nov 1989. 26p. Order Number DE90635425. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Practical considerations for the beam collector and output window design of a 35 GHz, 100 kW gyrotron are presented. A ballistic model for the electron flow in the collector region is developed with the subsequent determination of a large collecting are to withstand the power deposited by the impinging electron beam. The cooling system has been devised in order that the collector coll-down time be compatible with the pulsed regime of one shot per minute. Thermophysical properties of dielectric windows relevant to gyrotrons are also reported. (author).

43152 (LBL–28200) **Status of the Advanced Light Source.** Marx, J.N. Lawrence Berkeley Lab., CA (USA). Jun 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-900756–19: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90015636. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Advanced Light Source (ALS), now under construction at the Lawrence Berkeley Laboratory, will be a national user facility for the production of high-brightness and partially coherent soft x-ray and ultraviolet synchrotron radiation. The ALS is based on a low-emittance electron storage ring optimized for operation at 1.5 GeV with insertion devices in 10 long straight sections and 24 premier bend-magnet ports. High-brightness photon beams, from less than 10 eV to more than 2 keV, will be produced by undulators, thereby providing many research opportunities in materials and surface science, biology, atomic physics and chemistry. Wigglers and bend magnets will provide high-flux, broad-band radiation at energies to 10 keV. 6 refs., 6 figs., 2 tabs.

43153 (SSC–65) **Three dimensional ring configuration.** Garren, A.A. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Apr 1986. 11p. Sponsored by U.S. DOE Energy Research.

DOE Contract AC02-89ER40486. Order Number DE90015005. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A wide variety of three dimensional ring configurations are possible for the SSC, ranging from a horizontal plane ring to one that follows the terrain. This report discusses an efficient method of folding the ring along its major axis in a way that eliminates coupling effects over most of the ring. 7 refs., 2 figs.

43154 (SSC–66) **SSC [Superconducting Super Collider] monthly report, February 1986.** Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. [1986]. 38p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90015006. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses project summary, project report, and project cost data of the Superconducting Super Collider. (LSP)

43155 (SSC–77) **Magnet R&D for the SSC [Superconducting Super Collider].** Tigner, M. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Jun 1986. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-860583–9: International Committee for Future Accelerators workshop on superconducting magnets and cryogenics, Upton, NY (USA), 12-16 May 1986). Order Number DE90014645. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the following on the research and development of the superconducting magnets: dipole requirements; magnet research program; magnet quality-model results; and cryostat performance. (LSP)

43156 (SSC–114) **The superconducting super collider magnet system.** Karpenko, V.N. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–265: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014553. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Superconducting Super Collider (SSC) will have two 20-TeV proton beams traveling in opposite directions in separate storage rings in the same tunnel, 83 kilometers in circumference. Over 9600 superconducting magnets are required for bringing the beams into collision and for injection and abort. The magnet system is the single most costly technical system of the SSC. The use of superconductivity on a large scale is what makes the SSC practicable. 6 refs., 4 figs., 3 tabs.

43157 (SSC–117) **The SSC status and outlook.** Tigner, M. (Lawrence Berkeley Lab., CA (USA). SSC Central Design Group); Dahl, P. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–260: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014559. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The proposed Superconducting Super Collider is a high luminosity proton-proton collider designed to provide collisional energies at least an order of magnitude greater that those presently available at existing high energy physics facilities, or a maximum center-of-mass energy of 40 TeV. It will, thereby, be able to probe the 1–2 TeV scale – a frontier energy region believed to be replete with new physics. The technical feasibility of this ambitious undertaking is largely the result of recent advances in superconducting magnet technology. These advances, moreover, are the fruit of a nationwide R&D program, now in its fourth year, being coordinated by the SSC Central Design Group. The project is now well into the conceptual design stage. Development of technical sub-systems has begun. President Reagan has recently announced his support of the project, and congressional hearings on the matter have started. 5 refs., 6 figs.

43158 (SSC–120) **Modifications to the SSC lattice.** Garren, A.A.; Johnson, D.E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–262: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014557. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Possible modifications of the lattice described in the Superconducting Super Collider Conceptual Design Report of March 1986 have been considered and are presented below. One potential modification to the lattice is to change the arc cells in betatron phase advance from 60° to 90°, and to lengthen them to include six rather than five dipoles per half cell. Another related change is to make the dispersion suppressors shorter, and to include longer drift spaces for scrapers and detectors. 2 refs., 6 figs., 3 tabs.

43159 (SSC–123) **A design for a 2 km experimental straight section for the SSC [Superconducting Super Collider].** Johnson, D.E.; Toohig, T.E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–267: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014561. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The design of an experimental insertion for the SSC suitable for a very forward spectrometer is presented. This design has a usable space of ± 1000 m around the interaction point and can achieve a luminosity of approximately 10^{30} cm^{-2} s^{-1}. The design utilizes large-aperture quadruples which are part of the spectrometer array to focus the two beams. In order to achieve the necessary free space for this design, a beam bypass of one of the clustered straight sections if utilized. This bypass allows for the possibility of two, approximately 2.5 km sections free of horizontal dipole magnets. The bypass stubs needed to permit this possibility to be implemented in the future would increase the overall circumference of the SSC by roughly 3%. 3 refs., 4 figs., 1 tab.

43160 (SSC–226) **Radon in SSC tunnels.** Goss, D. Superconducting Super Collider Lab., Dallas, TX (USA). Oct 1989. 32p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014993. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Radon activity may be a source of radiation exposure in the SSC main ring tunnel. Typical radon activity concentrations for rock and soil on site are calculated. The effects of mitigation by tunnel sealing, lining and ventilating are discussed. 10 refs., 2 figs., 3 tabs.

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Refer also to citation(s) 43189

43161 (AD-A–220521/9/XAB) **Intense proton beam-plasma interactions.** Kraft, R.; Kusse, B.R. Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies. Nov 1983. 9p. (LPS–326). Source: NTIS, PC A02/MF A01.

A study has been initiated to investigate interactions between an intense proton beam and a background hydrogen plasma. The magnetic and electric neutralization of the ion beam by the plasma as well as collective interactions between the beam and the plasma are objects of this study. The plasma is produced by a conical theta-pinch gun and injected into a 2 kG solenoidal guide field. Plasma densities in the neighborhood of 10(10)/cc and electron temperatures of a 1-3 eV can be produced by careful operation of the plasma gun. The plasma column is 60 cm long and 2 cm in diameter. A 20 A/sq. cm proton beam is emitted from a magnetically insulated diode at 400 keV and injected axially into the plasma column. This paper presents a description of the experiment and some initial experimental results.

43162 (BNL–52248) **Snakes and spin rotators.** Lee, S.Y. Brookhaven National Lab., Upton, NY (USA). 18 Jun 1990. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90014754. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The generalized snake configuration offers advantages of either shorter total snake length and smaller orbit displacement in the compact configuration or the multi-functions in the split configuration. We found that the compact configuration can save about 10% of the total length of a snake. On other hand, the spilt snake configuration can be used both as a snake and as a spin rotator for

the helicity state. Using the orbit compensation dipoles, the spilt snake configuration can be located at any distance on both sides of the interaction point of a collider provided that there is no net dipole rotation between two halves of the snake. The generalized configuration is then applied to the partial snake excitation. Simple formula have been obtained to understand the behavior of the partial snake. Similar principle can also be applied to the spin rotators. We also estimate the possible snake imperfections are due to various construction errors of the dipole magnets. Accuracy of field error of better than 10^{-4} will be significant. 2 refs., 5 figs.

43163 (CTA-IEAv-RP–028/88) **Results from operation of metal melting electron gun.** Balloni, A.J.; Paes, A.C.J.; Miliano, A.C. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Sep 1988. 5p. (In Portuguese). Order Number DE90635440. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The first results obtained during the operation of metal melting electron gun, of power 30Kw and current 1,2A, developed at IEAv, are presented. Details on operation of beam transport system (composed by magnetic lens and prism), from generation to fusion chamber and cathode construction. Into the fusion chamber the presssure can reach 10^{-4}Pa, seeing that the gun test consisted in fusion for purification of approximatelly 1Kg titanium bar. The input average power was 12Kw, and the fusion remainded during 16 minutes. The calculated thermal efficiency was of the order of 10% consistent with the results found out in literature, for this type of gun. (M.C.K.).

43164 (FNAL/C–90/134) **Long-range beam-beam interactions in the Tevatron: Comparing simulation to tune shift data.** Saritepe, S.; Michelotti, L.; Peggs, S. Fermi National Accelerator Lab., Batavia, IL (USA). Jul 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900603–27: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90014984. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Fermilab upgrade plans for the collider operation include a separation scheme in the Tevatron, in which protons and antiprotons are placed on separate helical orbits. The average separation distance between the closed orbits will be 5σ (σ of the proton bunch) except at the interaction regions, B0 and D0, where they collide head-on. The maximum beam-beam total tune shift in the Tevatron is approximately 0.024 (the workable tune space between 5th and 7th order resonances), which was reached in the 1988–1989 collider tun. Helical separation scheme allows us to increase the luminosity by reducing the total beam-beam tune shift. The number of bunches per beam will be 6 in the 1991 collider tun, to be increased to 36 in the following collider runs. To test the viability of this scenario, helical orbit studies are being conducted. The most recent studies concentrated on the injection of 36 proton bunches, procedures related to opening and closing of the helix, the feed-down circuits and the beam-beam interaction. In this paper, we present the results of the beam-beam interaction studies only. Our emphasis is on the tune shift measurements and the comparison to simulation. 4 refs., 9 figs., 2 tabs.

43165 (SSC–63) **Beam-beam tune shifts and spreads in the SSC [Superconducting Super Collider]: Head on, long range, and PACMAN conditions.** Neuffer, D. (Texas Accelerator Center, The Woodlands, TX (USA)); Peggs, S. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Apr 1986. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014690. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This note analyses the regions of the tune plane which are occupied in a (nominal) model SSC which has two collision points with $\beta^* = 0.5$ metres, and two with $\beta^* = 10.0$ metres. The full crossing angle at each collision point is taken to be $\alpha^* = 75$ microradians, and the head on tune shift parameter is $\xi = -0.00084$, (significantly less than the SPS parameter $\xi_{SPS} \approx 0.004$). Long range beam-beam interactions take place in the free spaces on either side of the collision point, $\pm L = 72$ metres for the low beta IRs, and 150 metres in the high beta IRs, which are assumed for convenience to be pure drifts. Bunches in one beam are longitudinally separated from each other by $S_B = 4.8$ metres. In one variant of the model the transverse beam separation is vertical in all cases, while in a second variant alternate crossings are vertical and horizontal. In both of these cases the horizontal and vertical tune shifts of a test particle in a nominal bunch, and in a PACMAN bunch, are calculated and plotted as a function of its transverse amplitudes, (a_x, a_y), which are conveniently measured in units of σ, the rms size of the incident gaussian beam. Similar results to these have also been reported elsewhere.

43166 (SSC–67) **A theory of the coherent beam beam effects with long range interactions.** Forest, E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1986. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90015008. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We present an extension of the Chao-Ruth treatment of the Vlasov equation which includes both the head on and the long-range collisions. We also simplify the multiple bunches treatment by following the time evolution of a site instead of a bunch. Analytical results are obtained for the dipole mode and some numerical results for the higher modes.

43167 (SSC–68) **Comparison of various clustered interaction regions with regard to chromatic and dynamic behavior.** Leemann, B.; Wrulich, A. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. May 1986. 37p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90015009. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Clustered interaction regions for the SSC may be preferable from the viewpoint of costs and operation. In going from distributed to clustered IR's the superperiodicity of the machine is reduced and therefore the number of resonances induced by chromaticity correcting sextupoles is increased. This break in symmetry may cause a reduction in dynamic stability. The chromatic and dynamic behavior of the bare lattice is investigated for various cluster configurations. That means only chromaticity correcting sextupoles have been included and no magnetic imperfection errors have been considered. Then, the dynamic apertures of lattices with various IR clustering schemes are compared when random magnetic imperfections are included.

43168 (SSC–84) **Empirical Hamiltonians.** Peggs, S.; Talman, R. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Aug 1986. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-860870–25: 13. international conference on high energy accelerators, Novosibirsk (USSR), 7-11 Aug 1986). Order Number DE90014550. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

As proton accelerators get larger, and include more magnets, the conventional tracking programs which simulate them run slower. At the same time, in order to more carefully optimize the higher cost of the accelerators, they must return more accurate results, even in the presence of a longer list of realistic effects, such as magnet errors and misalignments. For these reasons conventional tracking programs continue to be computationally bound, despite the continually increasing computing power available. This limitation is especially severe for a class of problems in which some lattice parameter is slowly varying, when a faithful description is only obtained by tracking for an exceedingly large number of turns. Examples are synchrotron oscillations in which the energy varies slowly with a period of, say, hundreds of turns, or magnet ripple or noise on a comparably slow time scale. In these cases one may with to track for hundreds of periods of the slowly varying parameter. The purpose of this paper is to describe a method, still under development, in which element-by-element tracking around one turn is replaced by a single map, which can be processed far faster. Similar programs have already been written in which successive elements are "concatenated" with truncation to linear, sextupole, or octupole order, et cetera, using Lie algebraic techniques to preserve symplecticity. The method described here is rather more empirical than this but, in principle, contains information to all orders and is able to handle resonances in a more straightforward fashion.

43169 (SSC–105) **Equations of multiparticle dynamics.** Chao, A.W. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Jan 1987. 48p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-8610108–9: 2. joint US/CERN school on particle accelerators: frontiers of particle beams, South Padre Island, TX (USA), 23-29 Oct 1986). Order Number DE90014551. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The description of the motion of charged-particle beams in an accelerator proceeds in steps of increasing complexity. The first step is to consider a single-particle picture in which the beam is represented as a collection on non-interacting test particles moving in a prescribed external electromagnetic field. Knowing the external field, it is then possible to calculate the beam motion to a high accuracy. The real beam consists of a large number of particles, typically 10^{11} per beam bunch. It is sometimes inconvenient, or even impossible, to treat the real beam behavior using the single particle approach. One way to approach this problem is to supplement the single particle by another qualitatively different picture. The commonly used tools in accelerator physics for this purpose are the Vlasov and the Fokker-Planck equations. These equations assume smooth beam distributions and are therefore strictly valid in the limit of infinite number of micro-particles, each carrying an infinitesimal charge. The hope is that by studying the two extremes – the single particle picture and the picture of smooth beam distributions – we will be able to describe the behavior of our 10^{11}-particle system. As mentioned, the most notable use of the smooth distribution picture is the study of collective beam instabilities. However, the purpose of this lecture is not to address this more advanced subject. Rather, it has the limited goal to familiarize the reader with the analytical tools, namely the Vlasov and the Fokker-Planck equations, as a preparation for dealing with the more advanced problems at later times. We will first derive these equations and then illustrate their applications by several examples which allow exact solutions.

43170 (SSC–113) **Systematic multipoles and the linear aperture for the SSC.** Neuffer, D.V. (Los Alamos National Lab., NM (USA)); Peterson, J.M. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–266: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014552. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Superconducting Supercollider (SSC) requires an adequate linear aperture for reliable operation. Linear motion is required over a working region in amplitude and momentum space sufficient to include the beam size and momentum spread, closed-orbit deviations, and injection errors. For the SSC, the linearity requirement has been translated into a limit on orbit distortion or "smear" of 10% and a limit on amplitude and momentum dependent tune shifts $\Delta\nu < 0.005$ at betatron amplitudes A_x, A_y up to 0.005 m (maximum) in the SSC arcs over the momentum spread $\delta = \Delta p/p = \pm 1.0 \times 10^{-3}$, and at amplitudes up to 0.007 m at $p\Delta\ p/p = 0$. The implications of these tune-shift criteria on the tolerances for systematic and random multipole components of SSC magnets are discussed in this paper. The large circumference of the SSC makes it sensitive to effects that add coherently around the ring. The amplitude- and momentum-dependent tune shifts due to systematic multipole components in the SSC dipoles are particularly important. The linearity criteria set strict tolerances on SSC dipole systematic multipole components. The tolerances are strongly dependent on the strength of focusing in the SSC lattice, as discussed in this paper.

43171 (SSC–116) **Energy-loss of bunched beams in SSC [Superconducting Super Collider] RF cavities.** Furman, M. (Lawrence Berkeley Lab., CA (USA). SSC Central Design Group); Lee, H.; Zotter, B. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–268: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014560. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A bunched beam that is accelerated by the fundamental resonant mode of RF cavities necessarily loses energy by exciting the higher-order modes of these very cavities. We consider here the calculation of the power lost by gaussian bunches traversing a structure with resonator impedance of arbitrary quality factor. Known formulas are used for the infinite summations, which reduce to other approximate ones for the broad-band case. For the narrow-band case we present a simple analytic expression. We apply our results to calculate the power lost to the higher-order modes of the SSC RF cavities. Our conclusion is that if the resonant frequencies of all higher-order modes of the cavities are sufficiently far from integral multiples of the bunch frequency, the energy loss is strongly reduced over that calculated by a simple broad-band model; but if this condition is not satisfied, then the resulting resonant loss for even a weak mode may be several orders of magnitude greater than the broad-band calculation. 8 refs.

43172 (SSC–119) **A very large β^* interaction region for the SSC.** Groom, D.E.; Garren, A.A.; Johnson, D.E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–261: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014558. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Measurements of the p-p elastic scattering cross section into the Coulomb scattering region are important for determining the total p-p cross section, measuring the slope of the elastic cross section with momentum transfer, and normalizing the luminosity of the machine. At SSC energies, Coulomb scattering dominates only below 1 μrad. For the nominal SSC emittance ($\epsilon_N = 10^{-6}$m-rad), the angular spread of the beam is $6.8 \times \sqrt{1\ m/\beta^*}\ \mu$rad. For the contribution of this spread to be comparable to the desired experimental resolution, we require $\beta^* \approx 4000$ m. Moreover, to scan the cross section at larger angles it is desirable to tune β^* to smaller values. These requirements result in stringent IR design criteria: Crossing angles must be large to avoid disruption at bunch encounters, but not too large, in order to avoid synchro-betatron oscillations. At the same time, beams must pass through common triplet quadrupoles or be sufficiently separated for separate quadrupoles. 8 refs., 2 figs.

43173 (SSC–122) **Global beta measurement from two perturbed closed orbits.** Harrison, M. (Fermi National Accelerator Lab., Batavia, IL (USA)); Peggs, S. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–263: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014556. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A simple algorithm is presented which transforms two closed orbits observed at beam position monitors around a ring into β and ϕ values at the monitors. The procedure assumes the prior use of a second algorithm to measure β_c and ϕ_c at the two dipole correctors used to excite the perturbed closed orbits. Test results from the program BETA, written to measure β around the Tevatron, are shown. The sensitivities of the measurement to monitor digitisation and to quadrupole errors between the reference correctors are estimated. 4 figs.

43174 (SSC–133) **Brief description of the tracking codes FASTRAC and THINTRAC.** Leemann, B.T.; Forest, E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Jun 1987. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90015007. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

FASTRAC and THINTRAC are software packages that are unsuitable for "black-box-code operation," since they offer a lot of options which, if not understood properly by the user, can cause the program to crash or worse produce nonsensical results. However, they represent rather complete packages which permit to consistently extract information (factorized LIE – algebraic maps up to order 5) far beyond simple tracking results. This data interfaces very easily with the MARYLIE – type analysis routines and thus allows to do perturbation theory around a given orbit unlike MARYLIE itself. Any lack of "beauty and/or aestetic" is amply compensated for by its high degree of versatility, consistency and accuracy. 10 refs.

43175 (SSC–141) **Healy's modular approach to the computation of the general bending magnet map applied to the quadratic part of the Hamiltonian which is exact in $\Delta p/p_0$.** Forest, E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Oct 1987. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014686. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In the context of large machines the approximate Hamiltonian K, which is obtained by expanding to second order in the transverse variables while keeping the δ-dependence ($\delta = p - p_0/p_0$) exact, is often a legitimate representation of circular machines. One nebulous element has always been the general bending magnet. With the exception of the sector bend, many knowledgeable accelerator physicists have accepted the postulate that the parallel face bends can be obtained as P = QSQ, where Q are quadrupoles, and S is the sector bend matrix. This result is correct for δindependent linear maps. However, in this paper we will show how one proceeds to a correct solution using the Hamiltonian K and in particular, we will show that the trick of quadrupole edge breaks down in a proper δ-independent treatment. We will derive a slightly extended Maxwellian fringe field effect from what Dragt used in his paper on the chromaticity of small rings. Also, we will provide a δ-dependent matrix for the body of a parallel face bend. The approach we will follow relies heavily on the work of Liam Healy, who solved the general bend problem in the context of the code MARYLIE.

43176 (SSC–142) **Leading order hard edge fringe fields effects exact in $(1 + \delta)$ and consistent with Maxwell's equations for rectilinear magnets.** Forest, E. (Lawrence Berkeley Lab., CA (USA). SSC Central Design Group); Milutinovic, J. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group; Brookhaven National Lab., Upton, NY (USA). Oct 1987. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014687. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In a circular machine, where the linear lattice functions (α, β,γ) and a phase advance can be defined, one expects the fringe field effects to be negligible if the change in these functions is small through the element. However, this may not always be the case. In such situations, it is useful to have a leading order result which is adapted to tracking and analytical analysis. In this paper, we provide such a result for the quadrupole and we also provide a general formula for the effect of an arbitrary rectilinear multipole. Starting from the standard multipole expansion for the B field of a $2(n + 1)$-pole ($n \geq 1$), we compute the missing terms in the vector potential expansion consistent with the puree $2(n + 1)$- pole symmetry. We then compute the leading effects of the fringing fields of a multipole on the dynamics. Finally, we apply this result to quadrupoles and reproduce the original results of Graham Lee-Whiting, Matsuda, and Wollnik. For the quadrupole, we show how to write a symplectic (canonical) integrator for the dynamics which can be used in a standard circular machine kick code. For higher order multipoles, we display the implicit characteristic function solution as first proposed by Dragt. 12 refs.

43177 (SSC–220) **Machine constraints for experiments in an intermediate luminosity interaction region.** Groom, D. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. May 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014994. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We summarize existing information about the luminosity as a function of clear space between the interaction point and the front of the final-focus triplet, and about the minimum beam pipe dimensions (stay-clear dimensions) in the region. 7 refs., 4 figs., 1 tab.

4303 Auxiliaries and Components

Refer also to citation(s) 43155, 43211, 43609, 43610

43178 (DOE/ER/30142–T1) **Some novel sources of x-ray beams: Channeling, transition and Cherenkov radiation.** Fortson, N. Mitre Corp., McLean, VA (USA). Jason Program Office. Mar 1990. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-88ER30142. Order Number DE90014442. Source: NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

We discuss three types of x-ray sources which we have investigated as part of a JASON study for DOE of novel sources of short wavelength radiation. Other possible sources, such as VUV/XUV Free-Electron Lasers, are discussed in separate reports to DOE. Here we review channeling, transition, and Cherenkov radiation produced by fast electron or positron beams. Our work is based in part on material provided by Professor R.H. Pantell of Stanford University. 2 figs.

43179 (FNAL/C–90/122) **Beam diagnostics in circular machines: Review of new developments.** Jackson, G. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900603–28: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90014986. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Recent developments in beam diagnostic equipment and measurement techniques have been driven by commercial technological advances, better data analysis algorithms, and the need to measure complex beam properties. The need for such developments is due to the increased diversity, beam intensity, and luminosity/brightness requirements of charged particle circular accelerators. In addition, the advent of fast analog-to-digital converters and cheap, powerful microprocessors have fundamentally changed the approach to beam diagnosis, allowing designers to create systems where signal processing is performed locally at each detector. New beam monitors from a wide variety of circular accelerators are reviewed. A number of interesting or innovative ideas are presented in detail. 56 refs.

43180 (FNAL-TM–1669) **Experimental evaluation of vertically versus horizontally split yokes for SSC [Superconducting Super Collider] dipole magnets.** Strait, J.; Coulter, K.; Jaffery, T.; Kerby, J.; Koska, W.; Lamm, M.J. Fermi National Accelerator Lab., Batavia, IL (USA). 3 May 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900348–11: 2. international industrial symposium on the super collider, Miami, FL (USA), 14-16 Mar 1990). Order Number DE90014710. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The yoke in SSC dipole magnets provides mechanical support to the collared coil as well as serving as a magnetic element. The yoke and skin are used to increase the coil prestress and reduce collar deflections under excitation. Yokes split on the vertical or horizontal mid-plane offer different advantages in meeting these objectives. To evaluate the relative merits of the two configuration a 1.8 m model dipole was assembled and tested first with horizontally split and then with vertically split yoke laminations. The magnet was extensively instrumented to measure azimuthal and axial stresses in the coil and the cold mass skin resulting from cooldown and excitation. Mechanical behavior of this magnet with each configuration is compared with that of other long and short models and with calculations. 13 refs., 5 figs.

43181 (GSI–90-21(prepr.)) **Principles of non-Liouvillean pulse compression by photolonization for heavy Ion fusion drivers.** Hofmann, I. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 17p. (CONF-900113–: 5. international workshop on atomic physics for ion driven fusion, Schliersee (Germany, F.R.), 29 Jan - 4 feb 1990). Order Number DE90512900. Source: NTIS (US Sales Only), PC A03/MF A01.

Photoionization of single charged heavy ions has been proposed recently by Rubbia as a non-Liouvillean injection scheme from the linac into the storage rings of a driver accelerator for inertial confinement fusion (ICF). The main idea of this scheme is the accumulation of high currents of heavy ions without the usually inevitable increase of phase space. Here we suggest to use the photoionization idea in an alternative scheme: if it is applied at the final stage of pulse compression (replacing the conventional bunch compression by an rf voltage, which always increases the momentum spread) there is a significant advantage in the performance of the accelerator. We show, in particular, that this new compression scheme has the potential to relax the tough stability limitations, which were identified in the heavy ion fusion reactor study HIBALL.

Moreover, it is promising for achieving the higher beam power, which is suitable for indirectly driven fusion targets (10^{16} Watts/gram in contrast with the 10^{14} for the directly driven targets in HIBALL). The idea of non-Liouvillean bunch compression is to stack a large number of bunches (typically 50-100) in the same phase space volume during a change of charge state of the ion. A particular feature of this scheme with regard to beam dynamics is its transient nature, since the time required is one revolution per bunch. After the stacking the intense bunch is ejected and directly guided to the target. The present study is a first step to explore the possibly limiting effect of space charge under the conditions of parameters of a full-size driver accelerator. Preliminary results indicate that there is a limit to the effective stacking number (non-Liouvillean 'compression-factor'), which is, however, not prohibitive. Requirements to the power of the photon beam from a free electron laser are also discussed. (Abstract Truncated)

43182 (NIKHEF-K-LINO–1990-1) **Investigation of the application in 'PSPICE' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the DeGaussing of magnets.** Linden, A. van der. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. Mar 1990. 44p. (In Dutch). Order Number DE90635452. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

'PSpice', a MicroSim computer code to simulate electrical circuits, is also able to describe non-linear magnetic behaviour, by means of the application of the Jiles-Atherton model. However, in this investigation the 'PSpice' results show no agreement with the obvious relation between the parameters of the model and the well-known microscopic and macroscopic theory of magnetism. On the other hand, by means of 'trial and error' 'PSpice' simulations give a quantitative agreement with experimental data of magnet steel of the firm of 'Sigmaphi'. Based on these results, the degaussing of magnets has been studied. (author). 8 refs.; 14 figs.; 3 tabs.

43183 (SAND–90-0732C) **A macroscopic gas breakdown relationship.** Martin, T.H. Sandia National Labs., Albuquerque, NM (USA). [1990]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009221–1: 6. international symposium on gaseous dielectrics, Knoxville, TN (USA), 23-27 Sep 1990). Order Number DE90014372. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The design and construction of accelerators in the 100-terawatt class have significantly increased the demands placed on gas and liquid switching. The 100-terawatt PBFA 2 (Particle Beam Fusion Accelerator) uses 36 separate modules. Each module includes a Marx generator, a water-insulated energy store, a laser-triggered 5-MV switch, a 5-MV charge water pulse-forming line, and multiple self-breakdown megavolt water pulse sharpening switches. The resultant electrical pulse formed by PBFA 2 has subnanosecond syncronization in the main diode. During the analysis of the PBFA switching data, a scaling law was found that has implications for switch research and development. 11 refs., 4 figs., 1 tab.

43184 (SLAC-PUB–5276) **Effects and tolerances of injection jitter in the SLC and future linear colliders.** Limberg, T.; Seeman, J.T.; Spence, W.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-900603–29: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90014805. Source: NTIS, PC A02/MF A01; OSTI; INIS.

The bunch injected into the main linac of a linear collider may have offsets in transverse angle and position, may have a phase error (longitudinal position offset) and, furthermore, may be optically mismatched. Each of these injection errors reduces the luminosity and must be held within tolerances. The effect of optical mismatches on the emittance at the end of the linac is calculated analytically. The tightest tolerances on magnetic elements stemming from these effects are listed. The phase tolerance is determined by the energy acceptance of the final focus system. It imposes tolerances to the integrated field strength of the damping ring and RTL bending magnets and the bunch compressor rf-phase. In this paper, measurements of injection jitter and the effect of betatron oscillations caused by changes of the angle or position of the incoming beam are described. These measurements were taken with BNS damping which relaxes certain tolerances by an order of magnitude. The injection jitter tolerances for a linac of the next generation are given. As an example, parameters for the Next Linear Collider (NLC) being designed at SLAC are used.

43185 (SLAC-PUB–5282) **RF power generation for future linear colliders.** Fowkes, W.R.; Allen, M.A.; Callin, R.S.; Caryotakis, G.; Eppley, K.R.; Fant, K.S.; Farkas, Z.D.; Feinstein, J.; Ko, K.; Koontz, R.F.; Kroll, N.; Lavine, T.L.; Lee, T.G.; Miller, R.H.; Pearson, C.; Spalek, G.; Vlieks, A.E.; Wilson, P.B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9007111–13: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90014804. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The next linear collider will require 200 MW of rf power per meter of linac structure at relatively high frequency to produce an accelerating gradient of about 100 MV/m. The higher frequencies result in a higher breakdown threshold in the accelerating structure hence permit higher accelerating gradients per meter of linac. The lower frequencies have the advantage that high peak power rf sources can be realized. 11.42 GHz appears to be a good compromise and the effort at the Stanford Linear Accelerator Center (SLAC) is being concentrated on rf sources operating at this frequency. The filling time of the accelerating structure for each rf feed is expected to be about 80 ns. Under serious consideration at SLAC is a conventional klystron followed by a multistage rf pulse compression system, and the Crossed-Field Amplifier. These are discussed in this paper.

43186 (SSC–58) **Measurement of neutron spectra and doses in the Tevatron tunnel for 800 GeV circulating proton beams.** McCaslin, J.B. (Lawrence Berkeley Lab., CA (USA)); Sun, Rai-Ko S.; Swanson, W.P.; Elwyn, A.J.; Freeman, W.S.; Yurista, P.M. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. 3 Oct 1986. 71p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014689. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Measurements of the neutron fluence and energy spectrum were made in the Fermilab tunnel during Tevatron operation, using Bonner spheres and other instruments operated under various gated conditions. With a coasting beam of 10^{11} protons at 800 GeV, the average fluence rate at 2 m from the beam line was 3.6 cm^{-2} sec^{-1}. Comparison was made between spectra from the unfolding codes BUNKI, LOUHI and SWIFT, and reasonable agreement was found. There were no significant qualitative differences between spectra determined for Tevatron coasting beam conditions at 800 or 150 GeV or for Main Ring acceleration to 120–150 GeV at our location. When the unfolded spectra are plotted in lethargy units, in addition to the usual slowing-down component and thermal peak, a prominent peak is evident at about 0.23 MeV. About 30% of the fluence is contained between 100 keV and 1 MeV, and there is a surprising paucity of high-energy neutrons ($\approx$ 4% above 10 MeV). The median energy for the unfolded spectra is about 0.06 MeV and the average quality factor is close to 7.0. Values for the average neutron kerma factor in tissue and silicon are determined and upper limits are given for absorbed doses due to photons and minimum-ionizing particles. 32 refs., 18 figs.

43187 (SSC–60) **SSC [Superconducting Super Collider] injection simulation results.** Johnson, D.E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Feb 1986. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014693. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A computer model of the SSC lattice composed of 60° normal cells, dispersion suppressors and empty FODO cells has been developed in order to study the needed aperture for 1 TeV injection. The model has all elements as thin-lens kicks. Chromatic sextupoles have been included as well as all of the dipole random multipole errors, both normal and skew. Dipole magnets have been shuffled on b_2 in order to reduce the large sextupole errors. A set of slow horizontal and vertical dampers has been included. Ensembles of 500 randomly generated particles have been injected into this lattice with typical injection errors, and the effective beam size

increases after 100 turns have been observed. The lattice modeled in this study, with dipole errors corresponding to a 4 cm winding diameter, has an aperture sufficiently large to accomodate injection errors within the tolerances which have been adopted with an acceptable amount of beam dilution. 3 refs., 2 figs., 5 tabs.

43188 (SSC–71) **Plans for industrial production of the SSC [Superconducting Super Collider] magnets.** Karpenko, V.N.; Rardin, D.C. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. May 1986. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-860583–10: International Committee for Future Accelerators workshop on superconducting magnets and cryogenics, Upton, NY (USA), 12-16 May 1986). Order Number DE90015010. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Universities Research Association through its Central Design Group is currently conducting research and development for the Department of Energy on a superconducting super collider (SSC). The proposed SSC is a device in which protons would be accelerated around a ring approximately 50 miles in circumference. The protons would be kept in their path by means of thousands of powerful superconducting magnets. Two such rings of magnets would be housed in a common underground tunnel, allowing groups of protons to be accelerated in opposite directions and collided, in order to study the fundamental nature of matter and energy. The magnet system is a major element of the SSC in terms of technical requirements, quantity of components and cost. In order to meet technical and production requirements imposed by this system early participation of industry is necessary. The program plans were developed with the objective to involve industry in the early stages of research and development of superconducting magnets, leading to cost effective processes of potential mass production of high quality accelerator magnets by industry. While a decision has not been made by the Department of Energy on whether or not to request construction of the SSC project, if such a request is made and the project is authorized and funded, it would lead to industrial manufacture of a large quantity of superconducting magnets.

43189 (SSC–115) **Effect of the space-charge force on tracking at low energy.** Furman, M.A. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Mar 1987. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-870302–264: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987). Order Number DE90014555. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We present tracking result for the SSC's Low Energy Booster at injection energy, including the effect of the space-charge force. The bunches are assumed to be gaussian with elliptical cross-section. Magnet errors and sextupoles are not included, but an RF cavity is. We compare the phase space with and without synchrotron oscillations, with and without space-charge. The effective emittance is not significantly altered. We also present results on tune shifts with amplitude. 6 refs., 5 figs.

43190 (SSC–129) **Refrigeration plants for the SSC [Superconducting Super Collider].** McAshan, M.S. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. May 1987. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014691. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An overview of the SSC program is given, and a discussion of the many issues involved in specifying refrigeration plant is attempted. Significant progress in understanding these issues has been made since the publication of the central design report, and a principle tool of this understanding has been the development of a plant concept and the investigation of the system by means of static process simulation. This work has lead far enough so that system control strategies are being investigated and a very preliminary set of refrigeration plant criteria and derived. 10 refs., 4 figs., 6 tabs.

43191 (SSC–131) **Tables of thermodynamic properties of helium magnet coolant: 41 isobars in the range 1–5 atm and 3–5 K calculated from the equations of state of McCarty.** McAshan, M.S. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Jun 1987. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014692. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The most complete treatment of the thermodynamic properties of helium at the present time is the monograph by McCarty: "Thermodynamic Properties of Helium 4 from 2 to 1500 K at Pressures to 10^8 Pa," Robert D. McCarty, Journal of Physical and Chemical Reference Data, Vol. 2, page 923–1040 (1973). In this work the complete range of data on helium is examined and the P-V-T surface is described by an equation of state consisting of three functions $P(\rho,T)$ covering different regions together with rules for making the transition from one region to another.

43192 (SSCL-SR–1054) **Radiation damage testing at the SSC [Superconducting Super Collider]: Task Force report.** Chinowsky, W.; Thun, R. (eds.). Superconducting Super Collider Lab., Dallas, TX (USA). Jun 1990. 252p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90015560. Source: NTIS, PC A12/MF A01; OSTI; INIS.

A Task Force on Radiation Damage Testing met at the SSC Laboratory on March 5–6, 1990. This Task Force was asked to assess the availability of appropriate facilities for radiation damage tests of SSC detector materials and components. The Task Force was also instructed to review the techniques and standards for conducting such tests. Semiconductors were considered separately from other detector materials. Radiation damage test of electronic devices generally require exposures to both ionizing radiation and neutrons, whereas non-electric components such as plastic scintillating materials, adhesives, cable insulation, and other organic polymers are adequately tested with ionizing radiation only. Test standards are discussed with respect to irradiation techniques, environmental factors, dosimetry, and mechanisms whereby various materials are damaged. It is emphasized that radiation sources should be chosen to duplicate as much as possible the expected SSC environment and that the effects from ionizing particles and from neutrons be investigated separately. Radiation damage tests at reactors must be designed with particular care complex spectra of neutrons and gamma rays are produced at such facilities. It is also essential to investigate dose-rate effects since they are known to be important in many cases. The required irradiations may last several months and are most easily carried out with dedicated radioactive sources. Environmental factors such as the presence of oxygen when testing plastic scintillators, or temperature when measuring semiconductor annealing effects, must also be taken into account. The importance of reliable dosimetry is stressed and suitable references cited. Finally, it is noted that an understanding of the mechanisms for radiation damage in semiconductor and other materials is important in planning irradiations and evaluating results.

43193 **Variable energy constant current accelerator structure.** Anderson, O.A. To Dept. of Energy, Washington, DC. USA Patent 4912421/A/. 27 Mar 1990. Filed date 13 Jul 1988. USA Patent Application 7-218,390. Int. Cl. H05H 5/00. 14p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A variable energy, constant current ion beam accelerator structure is disclosed comprising an ion source capable of providing the desired ions, a pre-accelerator for establishing an initial energy level, a matching/pumping module having means for focusing means for maintaining the beam current, and at least one main accelerator module for continuing beam focus, with means capable of variably imparting acceleration to the beam so that a constant beam output current is maintained independent of the variable output energy. In a preferred embodiment, quadrupole electrodes are provided in both the matching/pumping module and the one or more accelerator modules, and are formed using four opposing cylinder electrodes which extend parallel to the beam axis and are spaced around the beam at 90° intervals with opposing electrodes maintained at the same potential.

4304 Storage Rings

43194 (GSI–90-23(prepr.)) **Can one crystallize a heavy ion beam?.** Hasse, R.W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 21p. (CONF-9005257–: International school on nuclear physics, Kiev (USSR),

28 May - 8 jun 1990). Order Number DE90512923. Source: NTIS (US Sales Only), PC A03/MF A01.

We study the possibility of obtaining liquid or crystalline ordered structures in a cooled heavy ion beam in a storage ring. First the structure of very cold ions confined in a cylindrically symmetric static potential is explored by means of molecular dynamics calculations. Liquid like structures are obtained for the ratio of average Coulomb to thermal energies and $\Gamma \simeq 10$ and crystalline structures like strings, zigzags, helices, tetrehedra, intertwined helices, polygons, etc. emerge for $\Gamma > 25$. For larger densities, the particles arrange in cylindrical shells and form equilateral triangles on their surfaces arranged in hexagons which are characteristic of two-dimensional Coulomb solids. The molecular dynamics results are compared to results of energy minimization of these structures or of geometrical models. Realistic molecular dynamics calculations in the lattice of the Experimental Storage Ring at GSI Darmstadt including the effects of the bending, focussing and defocussing magnets, of the free sections and of the electron cooler revealed that such structures at higher densities are easily destroyed by heating through shearing forces. Therefore the dynamics of the simple Coulomb string is explored in more detail. The potential energy for large amplitude longitudinal and transverse vibrations is calculated and the dispersion relations and response functions in the harmonic limit are given and possible excitation mechanisms are discussed. (orig.).

44 INSTRUMENTATION

43195 (CEA-LETI-RA–1988) **The 1988 Leti Division progress report.** CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1988. 148p. (In French). Order Number DE90512027. Source: NTIS (US Sales Only), PC A07/MF A01.

The 1988 progress report of the CEA's LETI Division (Division of Electronics, Technology and Instrumentation, France) is presented. The missions of LETI Division involve military and nuclear applications of electronics and fundamental research. The research programs developed in 1988 are the following: materials and components, non-volatile silicon memories, silicon-over-insulator, integrated circuits technologies, common experimental laboratory (opened to the European community), mass memories, photodetectors, micron sensors and flat screens.

4401 Radiation Instrumentation

Refer also to citation(s) 42556, 42557, 42585, 42586, 42587, 42588, 42589, 42590, 42591, 42592, 42593, 42594, 42595, 42596, 42597, 42598, 42599, 42600, 42601, 42705, 42706, 43008, 43285, 43480, 43492, 43509

43196 (BONN-IR–90-13) **Preparing calculations and measurements for the high-resolution tagging system TOPAS II at the Saphir detector.** Schneider, J.L. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Apr 1990. 64p. (In German). Order Number DE90513086. Source: NTIS (US Sales Only), PC A04/MF A01.

For the multi-particle detector system SAPHIR at ELSA a new high-resolution tagging system is under construction. This system will provide an energy resolution down to 2 MeV at 3,5 GeV end point energy. Two multi-wire proportional chambers with a total of 704 energy channels make this accuracy feasable. In addition 14 scintillation counters define the start time for the time-of-flight hodoscope of the hadron detector. In this paper calculations concerning the design and calibration of the system are presented as well as measurement in order to optimize the time resolution of the scintillation counters. The results show that with NE104 scintillators and EMI 9954 photomultipliers the design values of σ = 150 ps could be surpassed. (orig.).

43197 (BONN-IR–90-19) **Microwave systems for the dynamical nucleon polarization at 3.5 and 5 Tesla.** Weber, J. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. May 1990. 51p. (In German). Order Number DE90513087. Source: NTIS (US Sales Only), PC A04/MF A01.

Scattering experiments with polarized targets are planned at ELSA with the PHOENICS-detector and with ELAN. To increase the vector- and tensor polarisation of the target nucleons, higher magnetic fields for polarization are needed. This work describes the construction and test of two new microwave systems for the dynamic nuclear polarisation at magnetic fields of 3.5 T and 5 T. As microwave generator for the mesurement at 3.5 T, a IMPATT-diode is used. The necessary frequency width is attained by the use of a temperature regulation with 'Peltier'-elements. The frequency stability is achieved by a computer control and 'Phase-Locked-Loop'-control system. A frequency-measuring gauge for the measurement of frequencies around 140 GHz was constructed for the polarisation studies at 5 T. (orig.).

43198 (CIEMAT–644) **Preparation of ferric acetylacetonate, benzonate and caprate labelled with Fe-55 and tests of application to liquid scintillation measurements.** Los Arcos, J.M.; Rodriguez Barquero, L.; Grau Malonda, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain). 1990. 41p. (In Spanish). Order Number DE90635592. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The methods of preparation of ferric acetylacetonate, benzoate and caprate labelled with ^{55}Fe are described. The quenching effect, the spectral baehaviour and the count rate stability are studied by liquid scintillation measurements in toluene, INSTAGEL and HISAFE II, for two different values of the sample concentration. The ferric acetylaceton-ate is stable for all the three scintillators but shows a strong quench, while the ferric benzoate and caprate are stable only for INSTAGEL and HISAFE II showing no significant quench at the concentrat-ions of interest in habitual measurements. (Author).

43199 (CIEMAT–645) **Standarization of Mn-54 by liquid scintillation counting using organic samples of $(C_8H_{15}O_2)_2$ Mn-54.** Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain). 1990. 34p. (In Spanish). Order Number DE90635593. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A new method of standardization of Mn 54 by liquid scintillation counting with an organic sample of $(C_8H_{15}O_2)_2$ Mn 54 is described. This procedure shows a good long term stability of samples, over 20 days, and counting efficiencies between 10% and 24% for PCS e INSTAGEL and 10% 32% for a toluene-based scintillator. The discrepancies between experimental and computed values are less that 0,9% for PCS and INSTAGEL and less than 1,2% for Toluene, in the 5-2,5 interval of quenching parameter. The global uncertainty on the activity concentrat-ion of a sample standardized by this method has been lower than 3% (Author).

43200 (CIEMAT–646) **Evaluation of the ionization quenching correction for several liquid scintillators.** Los Arcos, J.M.; Borras, C. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain). 1990. 56p. (In Spanish). Order Number DE90635594. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The most appropiate computational model for the ionization quench-ing function Q(E) is analyzed for electrons in liquid scintillators. A numerical evaluation of Q(E) from 0.1 keV to 3 MeV which the kB parameter varying between 0.005 and 0.010 cm/MeV is presented for seven scintillators; Toluene, Toluene-Alcohol, PCS, Toluene-CC14, INSTAGEL, Dioxane-Naphtalene and HISAFE II. The numerical result are summarized as tables of least squares fitting coefficient which make easy the computation of Q(E).(Author).

43201 (CIEMAT–647) **Liquid scintillation counting efficiency in three photomultiplier systems. Pure electron capture.** Los Arcos, J.M.; Grau Malonda, A.; Grau Carles, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain). 1990. 73p. (In Spanish). Order Number DE90635595. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The tables of counting efficiency as a function of the figure of merit for a liquid scintillation counting system working with three phototubes are presented. The evaluation has been carried out for

a Toluene-Based scintillator with 5, 10 and 15 ml colume, and 19 differ-ent radionuclides decaying by pure electron capture: ^{37}Ar, ^{41}Ca, ^{49}V, ^{53}Mn, ^{55}Fe, ^{59}Ni, ^{68}Ge, ^{71}Ge, ^{82}Sr, ^{97}Tc, ^{118}Te ^{131}Cs, ^{137}La, ^{140}Nd, ^{157}Tb, ^{165}Er, ^{193}Pt, ^{194}Hg, ^{205}Pb. (Author).

43202 (CIEMAT–648) **Liquid scintillation counting efficiency for radionuclides decaying by electron capture and single gamma-ray emission.** Los Arcos, J.M.; Grau, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain). 1990. 101p. (In Spanish). Order Number DE90635596. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

In this paper, liquid scintillation counting efficiency v.s. a free parameter for E.C. and gamma-ray emitters has been computed. It is assumed that the decay scheme has only a gamma transition coincident with the E.C. Internal-conversion electrons of gamma photons may be emitted. The evaluation has been carried out for three different volumes, 5, 10 and 15 ml, of two scintillators, toluene and INSTAGEL, and thirteen radionuclides: ^{7}Be, ^{51}Cr, ^{54}Mn, ^{81}Kr, ^{110}Sn, ^{119}Sb, ^{125}I, ^{139}Ce, ^{143}Pm, ^{145}Sm, ^{152}Dy, ^{159}Dy, ^{166}Yb. (Author).

43203 (HMI-B–475) **A coincidence method for the simultaneous measurement of the photoionization of several masses. Study.** Broeker, G. Hahn-Meitner-Institut Berlin GmbH (Germany, F.R.). Nov 1989. 36p. (In German). Order Number DE90512918. Source: NTIS (US Sales Only), PC A03/MF A01.

This study was made in the working team Ding (Hahn-Meitner Institute Berlin) in the framework of photoionization experiments on Van-der-Waals clusters. The experiments were performed at the Berlin electron storage ring (BESSY). In a molecular-beam source clusters are produced and ionized by monochromatic light. The mass of the ions arising hereby is determined with a time-of-flight mass spectrometer. Within this thesis a method and an electronic device was developed, by which it is made possible to gather simultaneously the wave-length dependence of several masses. (orig.) With 27 refs.

43204 (INP–1372/PL) **Ferrous sulphate (Fricke) dosimetry in a fast neutron and a ^{60}Co radiotherapeutical beams.** Waligorski, M.P.R (Institute of Nuclear Physics, Cracow (Poland)); Zagrodzki, P.; Byrski, E. Institute of Nuclear Physics, Cracow (Poland). 1987. 20p. Order Number DE90635551. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Ferrous sulphate (Fricke) dosimetry was performed in the fast neutron beam produced at the U-120 cyclotron of the Institute of Nuclear Physics and in a ^{60}Co gamma-ray therapeutical beam at the Centre of Oncology in Krakow. The G-value was measured for the neutron component in the mixed (neutron + gamma) field of the fast neutron beam, where the mean neutron energy is 5.6 MeV. This value is G_n = 8.1 $\pm$ 0.6. Track structure theory calculations were made using energy spectra of charged secondary particles generated in water by the MRC Hammersmith fast neutron beam (mean neutron energy 7.6 MeV, measured value of G_n = 9.4 $\pm$ 0.6), yielding the calculated value of G_n = 8.61. Fricke dosimetry of the ^{60}Co beam indicates that the absolute value of gamma-ray dose at the Centre of Oncology may be underestimated by about 3% . 19 refs., 1 tab. (author).

43205 (INP–1373/PL) **Application of the alanine detector to gamma-ray, X-ray and fast neutron dosimetry.** Waligorski, M.P.R. (Institute of Nuclear Physics, Cracow (Poland)); Hansen, J.W.; Byrski, E. Institute of Nuclear Physics, Cracow (Poland). 1987. 24p. Order Number DE90635552. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A dosimeter based on alanine has been developed at the INP in Krakow and at Risoe National Laboratory. Due to its near tissue-equivalence and stability of signal, measured using ESR spectrometry at room temperature, this free-radical amino-acid dosimetric system is particularly suitable for measuring X-ray, gamma-ray and fast neutron doses in the range 10-10^5 Gy. The relative effectiveness (with respect to ^{60}Co γ-rays) of the alanine dosimeter to 250 kVp X-rays and to cyclotron-produced fast neutrons (mean neutron energy 5.6 MeV) is measured to be 0.76$\pm$ 0.06 and 0.60$\pm$0.05, respectively. The suitability of the alanine dosimeter for intercomparison gamma-ray dosimetry is also shown. The estimated absolute difference between ^{60}Co dosimetry at Risoe National Laboratory and at the Centre of Oncology in Krakow is about 5%, somewhat more than the experimental uncertainty. These results are based on ESR measurements performed in Krakow on about 25% of the exposed detectors. 28 refs., 2 figs., 3 tabs. (author).

43206 (INP–1378/E) **Spectroscopy analogue-to-digital converters: Present status and development trends.** Gruszecki, M. Institute of Nuclear Physics, Cracow (Poland). 1987. 70p. (In Polish). Order Number DE90635556. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

A review of world trends in the branch of electronic constructions for spectroscopy analogue-to-digital converters (ADC) applied in different fields of nuclear physics and techniques has been done. Data sheets and graphical comparison of main parameters for ADC that have appeared in world literature are also added. Recent methods applied for conversion of voltage pulse amplitude with linear coding scale have been described. Future trends up to year 1990 anticipating the increase of spectroscopy ADC resolution up to 15 bits and the shortening of ADC conversion time down to 1 μs have been presented. The dynamic development of very fast converters with low accuracy has been predicted. Present ADC are capable of sampling pulses from nuclear detectors with repetition rate up to 100 MHz. Examples of different correction methods for deleting ADC measurement errors show that both hardware and software tools may be used. On the ground of these methods one can use for spectroscopy ADC design commercially available integrated circuits with large scale integration. Then good metrology parameters, simplicity of realization and small overall dimensions may be obtained. These correction methods make a compromise between speed and precision of ADC operation possible. 81 refs., 22 figs., 3 tabs. (author).

43207 (INP–1396/PL) **A model of heavy ion detection in physical and biological systems.** Waligorski, M.P.R. Institute of Nuclear Physics, Cracow (Poland). 1988. 129p. Order Number DE90635600. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

Track structure theory (the Katz model) and its application to the detection of heavy ions in physical and biological systems are reviewed. Following the use of a new corrected formula describing the radial distribution of average dose around the path of a heavy ion, based on results of Monte Carlo calculations and on results of experimental measurements, better agreement is achieved between model calculations and experimentally measured relative effectiveness, for enzymatic and viral systems, for the Fricke dosemeter and for alanine and thermoluminescent (TDL-700) dosemeters irradiated with beams of heavy charged particles. From experimentally measured RBE dependences for survival and frequency of neoplastic transformations in a mammalian cell culture irradiated with beams of energetic heavy ions, values of model parameters for these biological endpoints have been extracted, and a model extrapolation to the low-dose region performed. Results of model calculations are then compared with evaluations of the lung cancer hazard in populations exposed to radon and its progeny. The model can be applied to practical phenomenological analysis of radiation damage in solid-state systems and to dosimetry of charged particle and fast neutron beams using a variety of detectors. The model can also serve as a guide in building more basic models of the action of ionizing radiation with physical and biological systems and guide of development of models of radiation risk more relevant than that used presently. 185 refs., 31 figs., 3 tabs. (author).

43208 (INP–1428/S) **Complex of programs for computer IBM PC dedicated to analysis of two dimensional coincidence matrixes.** Grebosz, J. Institute of Nuclear Physics, Cracow (Poland). Nov 1988. 18p. (In Polish). Order Number DE90635641. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

For IBM PC.

The complex of programs for computer IBM PC dedicated to analysis of two dimensional coincidence matrixes is presented. Such matrixes are used for instance in nuclear spectroscopy. (author).

43209 (LAL–89-17) **Study of the overlapping zones of the ALEPH electromagnetic calorimeter. Analysis of the light Higgs boson detection possibilities at LEP.** Marotte, V. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1989. 148p. (In French). Order Number DE90511910. Source: NTIS (US Sales Only), PC A07/MF A01.

The results of the work performed on the overlapping zones of an electromagnetic calorimeter are presented. The aim of the study is the development of an energy correction algorithm, taking into account the calorimeter granularity. The study is based on test beam data from the Monte Carlo detector. The developed algorithm allows energy correction better than seven percent and the improvement of the resolution. The research possibilities of Higgs boson at LEP are analyzed. The boson's mass is expected to be between the decay threshold of a pair of electrons and a pair of muons. The Higgs boson lifetime would be related to a secondary decay vertex. The Higgs boson production associated to a neutrino pair is also analyzed.

43210 (N–90-23294, pp. 125-132) **The sensitivity of EGRET to gamma ray polarization.** Mattox, J.R. (National Academy of Sciences - National Research Council, Greenbelt, MD (USA)). National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

A Monte Carlo simulation shows that EGRET (Energetic Gamma-Ray Experimental Telescope) does not even have sufficient sensitivity to detect 100 percent polarized gamma-rays. This is confirmed by analysis of calibration data. A Monte Carlo study shows that the sensitivity of EGRET to polarization peaks around 100 MeV. However, more than 10 (exp 5) gamma-ray events with 100 percent polarization would be required for a 3 sigma significance detection - more than available from calibration, and probably more than will result from a single score source during flight. A drift chamber gamma ray telescope under development (Hunter and Cuddapah 1989) will offer better sensitivity to polarization. The lateral position uncertainty will be improved by an order of magnitude. Also, if pair production occurs in the drift chamber gas (xenon at 2 bar) instead of tantalum foils, the effects of multiple Coulomb scattering will be reduced.

43211 (ORNL/FTR–3682) **[Silicon detectors for the Superconducting Super Collider]: Foreign trip report, June 26, 1990–July 7, 1990.** Bauer, M.L. Oak Ridge National Lab., TN (USA). 20 Jul 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014569. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Martin Bauer of Oak Ridge National Laboratory, William Bugg of the University of Tennessee, and John F. Walter of IntraSpec, Incorporated (a consultant to Oak Ridge National Laboratory,) traveled to Moscow and Dubna, USSR, Hamburg, FRG, and Copenhagen, Denmark, to gather information on the use of silicon as detector material for the SSC. The main topics of discussion were radiation hardness, calorimeter compensation, and silicon detector production. Data gathered on this trip showed that silicon continues to be an interesting and viable detector for calorimetry at the SSC. The question of the USSR's ability to produce the quantity and quality of silicon needed for the L-Star hadronic calorimeter will need careful follow-up over the next several years.

43212 (ORNL/TM–11531) **A neutron spectrometer based on optical detection of ^{3}He(n, p)^{3}H reactions in a gas.** Turner, J.E. (Oak Ridge National Lab., TN (USA)); Hamm, R.N.; Wright, H.A.; Hurst, G.S.; Huston, T.E.; Gibson, W.A. Oak Ridge National Lab., TN (USA). Jun 1990. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014776. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The conceptual framework is described for a new type of neutron spectrometer, based on the recently demonstrated principle of optical detection of charged-particle tracks in a gas. Whereas the elastic scattering of a neutron gives rise to the single track of a charged recoil particle, the reaction ^{3}He(n,p)^{3}H produces an event in which two tracks (those of the proton and triton) diverge from a common vertex at the capture site. The optical detection method, which allows direct visualization of tracks, could be used to distinguish between one- or two-pronged events. The measured total light output from an absorption event would be proportional to $T_p + T_t$, the sum of the initial kinetic energies of the proton and triton. Independently of its incident direction, the energy of the absorbed neutron would be given by $T = T_p + T_t - Q$, where $Q = 765$ keV is the energy released by the reaction. 5 refs., 1 figs.

43213 (RAL–89-123) **Second coordinate measurement in drift chambers by time difference.** White, D.J. Rutherford Appleton Lab., Chilton (UK). Dec 1989. 15p. Order Number DE90635564. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Extremely high performance is required of electronics used on drift chambers for second coordinate measurement by time difference. Amplifiers must have very low noise and discriminators must have low, well matched walk characteristics to achieve good resolution and accuracy. Front end circuitry must be protected against chamber breakdown for reliable operation and match the chamber characteristic impedance well for optimum measurement linearity. (author).

43214 (SSC–219) **EMPACT: An alternative approach to a high P_T SSC experiment.** Marx, M. (Lawrence Berkeley Lab., CA (USA). SSC Central Design Group). Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. May 1989. 51p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014995. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

A survey of high P_T detector concepts advanced for the SSC reveals two striking facts – first, the scale of most detectors is set by the muon detection system; and second, that the performance of these muon systems is limited in comparison to electron or jet capabilities, either in resolution or in rapidity acceptance. I propose here an alternative concept for an SSC experiment which will provide enhanced muon performance at a level to that obtainable through calorimetric means for electrons and jets, while drastically reducing the tonnage of the experiment.

43215 **3-hydroxyflavone doped scintillators in high energy physics applications.** Pla-Dalmau, A. (Fermi National Accelerator Lab., Batavia, IL (USA)); Bross, A.D.; Spangler, C.W. pp. 72 of American Chemical Society, Division of Physical Chemistry. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

During the past several years, organic fluors have been developed and studied as organic scintillators in detectors for high energy physics. The authors effort has focussed on 3-hydroxyflavone and some of its ortho- and para-phenyl substituted derivatives. Their main feature is the large Stokes shift undergone under excitation by UV light or gamma irradiation due to excited-state intramolecular proton transfer (ESIPT). These organic materials have been studied as 1% guests in a polystyrene host medium. Here they present their absorbance and fluorescence characteristics, quantum yield values as a function of temperature down to liquid helium temperature, and a comparison of their relative efficiencies and applicability as detectors.

4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to citation(s) 42978, 42979, 42980, 42981, 42982, 43020, 43145

43216 (SAND–90-1894C) **Modeling the anneal of radiation-induced trapped holes in a varying thermal environment.** McWhorter, P.J.; Miller, S.L.; Miller, W.M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900723–13: 27. IEEE annual international nuclear and space radiation effects conference, Reno, NV (USA), 16-20 Jul 1990). Order Number DE90014374. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The anneal of radiation induced trapped holes in MOS transistors is found to be thermally activated. A quantitative, physical model is developed which accurately predicts the anneal of radiation-induced trapped holes in constant or time varying thermal environments. Data is presented which quantitatively verifies the accuracy of the model for temperatures between 25 and 160°C. The model results are demonstrated to be consistent with a large body of data in the literature. This model provides the basis for developing accurate quantitative screens for the rebound failure mechanism. 16 refs., 9 figs.

43217 **Laser induced damage in optical materials. 1986.** NIST special publication 752. Bennett, H.E. (Naval Weapons Center, China Lake, CA (USA)); Guenther, A.H.; Milam, D.; Newnam, B.E. 694p. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

This book contains the proceedings of a symposium on optical materials for high power lasers. The papers include: Mass spectrometric studies of laser damage in calcium fluoride and Radiation hardness of Nd:YAG and Nd:Cr:GSGG laser rods.

43218 **Long-range pulse length scaling of 351 nm laser damage thresholds.** Foltyn, S.R. (Los Alamos National Lab., Los Alamos, NM (US)); Jolin, L.J. pp. 336-343 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

This paper reports how, in a series of experiments incorporating 351-nm pulselengths of 9, 26, 54, and 625 ns, it was found that laser damage thresholds increased as (pulselength)^x, and that the exponent averaged 0.36 and ranged, for different samples, from 0.23 to 0.48. Similar results were obtained when only catastrophic damage was considered. Samples included Al_2O_3/SiO_2 in both AR and HR multilayers. HR's of Sc_2O_3/SiO_2 and HfO_2/SiO_2, and an Al- on-pyrex mirror; 9-ns thresholds were between 0.2-5.6 J/cm^2. When these data were compared with a wide range of other results - for wavelengths from 0.25 to 10.6 μm and pulselengths down to 4 ps - a remarkably consistent picture emerged. Damage thresholds on average, increase approximately as the cube-root of pulselength from picoseconds to nearly a microsecond, and do so regardless of wavelength or material under test.

43219 **Time to failure in single pulse laser induced damage in thin film optical coatings.** Boyer, J. (Los Alamos National Lab., Los Alamos, NM (US)). pp. 344 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Measurement of the time between the start of the laser pulse and the disruption of the irradiated surface provides information not available in traditional damage measurements. The importance of the rate of energy input versus the total energy deposited may be studied by varying the pulse energy and measuring the time at which damage is initiated. If the diagnostics are of adequate sensitivity, a damage threshold fluence can be assigned to each damage event and the fluence distribution of the defect population can be measured. The author discusses the test configuration and diagnostics for both transmitting and reflecting coatings. Preliminary data at 248 nm with a 23 ns pulse length are presented.

43220 **The effect of layer thickness errors in the design of coatings with reduced electric field intensity.** Keller, G.L. (Los Alamos National Lab., Los Alamos, NM (US)). pp. 505 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Many papers have been written on the design of laser-damage-resistant high reflectors. Usually, reduction in the peak electric-field intensity in the outermost layers of a multilayer stack is studied. In this work, the effect of random and systematic errors in the quarter-wave stack below the enhanced layers is investigated. Also, optical monitoring errors in the optimized layers and their relation to the standing-wave electric field through the multilayer stack are discussed.

43221 **Impact of thermal blooming on laser damage measurement accuracy.** Newman, B.E. (Los Alamos National Lab., Los Alamos, NM (US)). pp. 531 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

The presence of thermal blooming in laser damage experiments conducted in air frequently goes unnoticed. For certain conditions, however, this effect can result in significant errors in determining the magnitude of damage thresholds. Thermal blooming of a laser beam is a direct result of nonuniform heating of the transmitting medium (air) across the laser beam diameter. The resultant changes in refractive index cause the laser beam to diverge. In a laser damage experiment the test sample is often placed in the focal plane of a positive lens. With thermal blooming, however, the actual focus of the high-intensity laser beam can occur significantly in front of the sample, resulting in overestimates of the damage threshold. Using the formulation for a focused Gaussian beam, the authors calculate the magnitude of possible errors for damage thresholds of surfaces and thin films measured in air with various wavelengths.

4405 Thermal Instrumentation

Refer also to citation(s) 42640

4406 Optical Instrumentation

Refer also to citation(s) 42610, 43217, 43218, 43219, 43220, 43227, 43430

43222 (UCRL-JC–103743) **A new low density, high porosity lithium hydride-beryllium hydride foam: Properties and applications to x-ray astronomy.** Maienschein, J.L.; Barry, P.E.; McMurphy, F.E.; Bowers, J.S. Lawrence Livermore National Lab., CA (USA). Jun 1990. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900756–18: SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90015150. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a low density (30–670 kg/m^3), high porosity (up to 96%) foam containing lithium hydride and amorphous beryllium hydride. This foam may be attractive as the x-ray scattering element in experiments such as the Thomson Scattering Polarimeter as proposed for inclusion in the High Throughput X-Ray Spectroscopy Space Mission, XMM, sponsored by the European Scientific Agency. We discuss ways to synthesize the foam, and report on physical properties such as bulk density and porosity, electron density, uniformity of foam density, concentration of impurities, pore size distribution, and sensitivity to moisture. The composition of the foam can be varied, but equimolar mixtures of LiH and BeH_2 give the most vigorous foaming reaction. The force needed to expand the plastic reaction mass into a foam is provided by hydrogen and organic contaminants in the beryllium hydride that are released during the foaming reaction. Simultaneous differential thermal analysis and thermogravimetric analysis show that the reaction is endothermic with very little mass loss. The presence of $LiBeH_3$ as either a reaction intermediate or final product is suggested by the fact that the most vigorous foaming occurs with equimolar mixtures of lithium hydride and beryllium hydride. 8 refs., 4 figs., 3 tabs.

43223 (UCRL-JC–104338) **Noise performance of microchannel plate imaging systems.** McCammon, K.; Hagans, K.; Hankla, A. Lawrence Livermore National Lab., CA (USA). 26 Jun 1990. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900756–17: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order

Number DE90015037. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present a characterization of the significant noise mechanisms is a microchannel image intensifier and CCD image recording system intended for applications in ultrafast imaging systems used at LLNL for nuclear science. The system under study consists of a generation two image intensifier, a relay lens, and a cooled CCD imaging array of 640 by 1024 pixels. Fixed pattern noise is significantly reduced by flat fielding techniques. The remaining major noise mechanisms are the intensifier shot noise and a noise factor that characterizes the non-idealness of the system. Results are given for the intensifier noise factor's functional dependence on input irradiance levels, gain settings, and accelerating voltages. 3 refs., 6 figs.

43224 Multichannel optical sensing device. Selkowitz, S.E. To Dept. of Energy, Washington, DC. USA Patent 4915500/A/. 10 Apr 1990. Filed date 16 Aug 1985. USA Patent Application 7-766,168. Int. Cl. G01J 1/42. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A multichannel optical sensing device is presented, for measuring the outdoor sky luminance or illuminance or the luminance or illuminance distribution in a room, comprising light receptors, an optical shutter matrix including liquid crystal optical shutter elements operable by electrical control signals between light transmitting and light stopping conditions, fiber optic elements connected between the receptors and the shutter elements, a microprocessor based programmable control unit for selectively supplying control signals to the optical shutter elements in a programmable sequence, a photodetector including an optical integrating spherical chamber having an input port for receiving the light from the shutter matrix and at least one detector element in the spherical chamber for producing output signals corresponding to the light, and output units for utilizing the output signals including a storage unit having a control connection to the microprocessor based programmable control unit for storing the output signals under the sequence control of the programmable control unit.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 42584, 42910, 42987, 43017, 43029, 43043, 43062, 43427

43225 (EGG–10617-1088) **Computer simulation of microtriode performance.** Mobley, R.M. (EG and G Energy Measurements, Inc., Woburn, MA (USA)); Boers, J.E. EG and G Energy Measurements, Inc., Woburn, MA (USA). [1990]. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. (CONF-9007125–1: IEEE international vacuum microelectronics conference, Monterey, CA (USA), 23-25 Jul 1990). Order Number DE90014191. Source: NTIS, PC A - OSTI.

The work presented here is part of an evaluation of the use of field emitter arrays (FEAs) for use in fast cathode ray oscilloscopes (CRTs). Fast CRTs typically have bandpass of several GHz, corresponding to step function risetime response of 100 picoseconds or less. High beam brightness is desirable since the limiting apertures of the deflection structures are small, typically .030 inches diameter at a distance of 10 inches from the gun. The spot size on the screen and the current are limited by the well-known universal beam spreading relationship (1). It is generally possible to reach these limits using conventional oxide cathodes. Since FEAs are inherently "patchy" and "bumpy" emitters, which are known deleterious effects for flat cathodes, it is questionable whether such arrays can be used effectively in fast CRTs. If the answer is yes, then there are at least two advantageous features of FEA guns as follows: (1) faster turn-on using an impedance-matched mounting, and (2) no grid emission. The simulations presented here show that under certain assumptions arrays with 10 microamps of emission/tip can produce beam brightness reaching the universal beam spread limit. 2 refs., 13 figs.

43226 (KCP–613-4292) **Using embedded microcontrollers in radar test equipment.** Binney, R.S.; Riblett, L.E. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1990. 32p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. (CONF-9005175–2: Automatic RF Technology Group (ARFTG) conference, Dallas, TX (USA), 10-11 May 1990). Order Number DE90014997. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

With the recent advancements in microcontroller technology, radar test equipment can be designed to improve the accuracy of measurements being made and simplify designs. An embedded integrator monitor design application (hardware and software) is presented and comparisons are made between the embedded design and the more traditional discrete design approach. 23 figs.

43227 (LA-UR–90-2321) **VISAR [Velocity Interferometer System for Any Reflector]: Displacement-mode data reduction.** Hemsing, W.F. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900756–15: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90015027. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A Velocity Interferometer System for Any Reflector (VISAR) is a laboratory tool that measures high velocities by continuously measuring the Doppler shift of laser light reflected from a moving surface. It produces lower output frequencies than a displacement interferometer in which Doppler-shifted laser light from a moving target is mixed with unshifted laser light. To obtain lower frequencies, a VISAR employs a wide-angle Michelson interferometer with a time delay in one leg. Undelayed and delayed light rays are thus mixed to detect the relatively small difference between two Doppler shifts produced by accelerating motion at two slightly different velocities. In most VISAR data reduction programs, the velocity is assumed to be proportional to the interferometer fringe count at any instant. This yields velocity details that are inaccurate over the interferometer delay time. In the examples of this paper, the signal time resolution was shorter than the interferometer delay. The subject of this paper is a data reduction method that uses the displacement information in suitable VISAR signals to recover velocity features that occur during the interferometer delay. 9 refs., 8 figs.

43228 (N–90-22918) **Spatial Displays and Spatial Instruments.** Ellis, S.R.; Kaiser, M.K.; Grunwald, A.J. National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center. Jul 1989. 623p. (NASA-CP–10032;A–88090;NAS–1.55:10032;CONF-8708156–: Spatial displays and spatial instruments, Asilomar, CA (USA), 31 Aug - 3 sep 1987). Source: NTIS, PC A99/MF A04.

The conference proceedings topics are divided into two main areas: (1) issues of spatial and picture perception raised by graphical electronic displays of spatial information; and (2) design questions raised by the practical experience of designers actually defining new spatial instruments for use in new aircraft and spacecraft. Each topic is considered from both a theoretical and an applied direction. Emphasis is placed on discussion of phenomena and determination of design principles.

43229 Particle separator. Hendricks, C.D. To Dept. of Energy, Washington, DC. USA Patent 4913807/A/. 3 Apr 1990. Filed date 26 Oct 1988. USA Patent Application 7-262,632. Int. Cl. B03B 4/00. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

Method and apparatus are described for separating and classifying particles by dispersing the particles within a fluid that is upwardly flowing within a cone-shaped pipe that has its large end above its small end. Particles of similar size and shape migrate to individual levels within the flowing fluid. As the fluid is deflected by a plate at the top end of the pipe, the smallest particles are collected on a shelf-like flange. Ever larger particles are collected as the flow rate of the fluid is increased. To prevent particle sticking on the walls of the pipe, additional fluid is caused to flow into the pipe through holes that are specifically provided for that purpose. Stocking is further prevented by high frequency vibrators that are positioned on the apparatus.

43230 Tube curvature measuring probe and method. Sokol, G.J. To Dept. of Energy, Washington, DC. USA Patent 4910877/A/.

27 Mar 1990. Filed date 18 Jul 1988. USA Patent Application 7-220,200. Int. Cl. G01B 7/28. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a probe and method for measuring the radius of curvature of a bend in a section of tubing. The probe includes a member with a pair of guide means, one located at each end of the member. A strain gauge is operatively connected to the member for detecting bending stress exerted on the member as the probe is drawn through and in engagement with the inner surface of a section of tubing having a bend. The method of the present invention includes steps utilizing a probe, like the aforementioned probe, which can be made to detect bends only in a single plane when having a fixed orientation relative the section of tubing to determine the maximum radius of curvature of the bend.

43231 Superlattice strain gage. Noel, B.W.; Smith, D.L.; Sinha, D.N. To Dept. of Energy, Washington, DC. USA Patent 4912355/A/. 27 Mar 1990. Filed date 28 Jun 1988. USA Patent Application 7-212,854. Int. Cl. H01L 41/08. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A strain gage comprising a strained-layer superlattice crystal exhibiting piezoelectric properties is described. A substrate upon which such a strained-layer superlattice crystal has been deposited is attached to an element to be monitored for strain. A light source is focused on the superlattice crystal and the light reflected from, passed through, or emitted from the crystal is gathered and compared with previously obtained optical property data to determine the strain in the element.

43232 Apparatus and method for performing two-frequency interferometry. Johnson, R.G. To Dept. of Energy, Washington, DC (USA). USA Patent 4906095/A/. 6 Mar 1990. Filed date 25 Jan 1988. USA Patent Application 7-147,468. Int. Cl. G01B 9/02. 12p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an apparatus that includes a two-frequency, Zeeman-effect laser and matched, doubly refracting crystals in the construction of an accurate interferometer. Unlike other interferometric devices, the subject invention exhibits excellent phase stability owing to the use of single piece means for producing parallel interferometer arms, making the interferometer relatively insensitive to thermal and mechanical instabilities. Interferometers respond to differences in optical path length between their two arms. Unlike many interferometric techniques, which require the measurement of the location of interference fringes in a brightly illuminated background, the present invention permits the determination of the optical path length difference by measuring the phase of an electronic sine wave. The apparatus is demonstrated as a differential thermooptic spectrometer for measuring differential optical absorption simply and accurately which is but one of many applications therefor.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

43233 (UCID–104631) **Implications of German unification for United States military forces in The Federal Republic of Germany.** Zinner, P.E. Lawrence Livermore National Lab., CA (USA). Jul 1990. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014738. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this study is to analyze the possible impact of German unification on the terms and conditions of continued stationing of United States troops on the territory of the Federal Republic of Germany. This study is one of a series of planned reports dealing with the causes and effects of military force reductions in Europe.

43234 (UCRL-CR–104676) **Simulation software specification for the Urban Combat Computer Assisted Training System (UCCATS).** Dobbs, L.A. (Army (U.S.) Berlin Brigade (Germany, F.R.)); Toms, R. Lawrence Livermore National Lab., CA (USA); Army (U.S.) Berlin Brigade (Germany, F.R.). 16 Mar 1990. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015364. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The United States Army, Berlin and its Berlin Brigade have an urgent requirement for a training system that can provide a realistic, stress-filled, simulated combat training environment for an urban battlefield. The simulation system will support the training of division/brigade/battalion commanders and their staffs to exercise procedures and decision making which will be essential to win on a modern urban battlefield. The current manual simulation used by the Berlin Brigade requires an excessive amount of time for pre-exercise set up and training of players and controllers. The manual simulation requires a large training support staff consisting of 40 to 60 personnel per shift. In addition, the current simulation has numerous modeling deficiencies reducing the quality of the combat representation to the extent that realistic training is not feasible in many circumstances. The computer assisted simulation system UCCATS will provide a means to more efficiently support realistic training for combat in the urban environment. UCCATS will support the training of a division/brigade/battalion commander and his staff. It will exercise commanders and staff in the command and control of combined arms operations in an urban terrain environment.

4501 Chemical Explosions and Explosives

43235 (LA-UR–90-2427) **Study of the induction time in isothermal decomposition of explosives.** Stinecipher, M.M.; DuBois, F.W.; Baytos, J.F. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9009223–1: 19. annual North American thermal analysis society conference, Boston, MA (USA), 23-26 Sep 1990). Order Number DE90014906. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The high explosives (HEs) HMX, RDX, and TATB, were studied in the isothermal-age mode in the accelerating rate calorimeter (ARC) in the solid state at temperatures well below their rapid decomposition temperatures. The ARC maintained the temperature chosen until it detected an exotherm greater than 0.01 °C/min, at which time heaters in the walls of the calorimeter were programmed to keep the calorimeter at the same temperature as the sample cell. If during its induction time at elevated temperature HMX was cooled and reheated, the total induction time remained the same as that of an uncooled sample. However, if the cooled sample was ground to release any trapped gases after the first heating, then the induction time was extended. Mass spectrometry was used to identify the trapped gases. 7 refs., 1 fig.

4502 Nuclear Explosions and Explosives

43236 (SAND–85-2523-Rev.2) **Procedures for DOE-Navy exchange and approval of engineering information and material management required for production of W88- 0/Mk5 RBA [reentry body assembly]: Revision 2.** Alvis, R.L.; Barkocy, E.J. Sandia National Labs., Albuquerque, NM (USA). Apr 1990. 41p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90014763. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report [Grey Book] establishes the procedures whereby information pertaining to the W88-0/Mk5 RBA, Mk5 JTA, reentry body, and associated test equipment configurations and nonconformances will be exchanged and approved by the US Navy and DOE agencies. Material management procedures common to the Navy and the DOE will be implemented according to the provisions agreed to and reported here. Parties to this agreement are: Department of the Navy Strategic Systems Program Office; Department of Energy Albuquerque Operations Office; Navy Contractor (Lockheed Missiles and Space Co., Inc.); Mason & Hanger-Silas Mason Co., Inc., Pantex Assembly Plant; Los Alamos National Laboratory; Sandia National Laboratories. 19 refs., 10 figs., 1 tab.

4504 Nuclear and Radiological Warfare

43237 (SAND–90-1513) **Future Look: Volume 1.B, The future world in Europe and its implications for the security and**

survivability of non-strategic nuclear forces. Yarnall, C.A.; Caruthers, J.R. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 35p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90014743. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This study was performed under FUTURE LOOK, a joint Defense Nuclear Agency/Department of Energy (DNA/DOE) sponsored study. The intent of FUTURE LOOK is to identify and develop means of providing requisite security and survivability to the Non-Strategic Nuclear Forces (NSNF) in the Twenty-First Century. Our current thinking about the future world in Europe is summarized. In this report we develop four scenarios/stockpile cases to cover the spectrum of potential happenings in Europe; we also develop general security and survivability implications and recommendations for each case. The four cases are: (1) a substantially reduced (factor of 2–10) European stockpile: (2) a near-zero stockpile, with no Army weapons remaining in Europe; (3) current stockpile in Europe remains; and (4) current stockpile numbers remain, but aggressive modernization is allowed. We plan to use the information in this report to assist in developing detailed security and survivability options as part of our follow-on to FUTURE LOOK studies. 8 refs., 6 tabs.

54 ENVIRONMENTAL SCIENCES

43238 (IVL-B–981) **Nitrogen as environmental pollutant.** Swedish Environmental Research Inst., Stockholm (Sweden). Mar 1990. 76p. (In Swedish). (CONF-9002133–: IVL-Konferensen 1990, Stockholm (Sweden), 14 Feb 1990). Order Number DE90512646. Source: NTIS (US Sales Only), PC A05/MF A01.

Summary of 15 lectures.

The report comprises summaries of the talks of the IVL (Swedish Environmental Research Institute) conference 1990 with the same name as the report title. The lectures were presented under the following headings: * Nitrogen chemistry and cycle in nature. * Local and regional dissemination of nitrogen compounds. * Nitrogen as a pollutant - effects and dissemination. * Discharge of nitrogen compounds and measures to reduce nitrogen discharges. * Organic nitrogen compounds - A future environmental problem? * How do we value various discharges of nitrogen compounds?.

43239 (ORNL–6619) **Biomedical and Environmental Sciences Program publications 1989.** Johnson, C.A.; Ellis, J.R.; Gibson, K.N.; Norman, V.S.; Rader, K.J.; Rhew, D.D. Oak Ridge National Lab., TN (USA). Jul 1990. 113p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE90014785. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This bibliography contains approximately 600 references to journal articles, books, book chapters, proceedings, reports, and abstracts published during 1989 under Oak Ridge National Laboratory Biomedical and Environmental Sciences programs. Publications authored by members of the Biology Division, Environmental Sciences Division, and Health and Safety Research Division are listed in addition to those authored by members of division that receive funding through the Associate Laboratory Director for Biomedical and Environmental Sciences. Some references from 1988 that were not entered into the Laboratory Records data base in time for the previous publication are also included in this document. The bibliography is organized by technical category, then by division, and, within each division, alphabetically by the senior author. An index of authors is also provided. Publications listed in this bibliography include 284 journal articles and abstracts, 224 of which appeared in refereed sources; 196 reports; 54 proceedings; and numerous books, book chapters, and miscellaneous publications. Publications not referenced in this document include theses, dissertations, book reviews, most documents or reports prepared for internal distribution, letters to editors, and abstracts published in nonreferenced sources.

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 42559, 42660, 42723, 42773, 42774, 42844, 42870, 42880, 42893, 42932, 42983, 43102, 43294, 43297, 43335, 43621, 43622

43240 (ANL/EAIS/TM–17) **Responding to the threat of global warming: Options for the Pacific and Asia.** Streets, D.G.; Siddiqi, T.A. (eds.). Argonne National Lab., IL (USA). [1989]. 526p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-31109-ENG-38. (CONF-8906244–: Responding to the threat of global warming: options for the Pacific and Asia, Honolulu, HI (USA), 21-27 Jun 1989). Order Number DE90014756. Source: NTIS, PC A23/MF A01 - OSTI; GPO Dep.

In June 1989, Argonne National Laboratory and the Environment and Policy Institute of the East-West Center jointly sponsored a workshop that was held at the East-West Center in Honolulu, Hawaii. The primary goal of the workshop was to explore the options that the countries of the Pacific and Asia have for dealing with the threat of global warming. The countries of the Pacific and Asia must address a variety of issues related to global warming, ranging from determining the advisability of reducing greenhouse-gas emissions to assessing the vulnerability of various communities to the consequences of climate change only adds to the many other important health and socioeconomic problems they must face. The goal of this workshop was to bring together policy makers, scientists, and analysts who are concerned about the issue of climate change in this region so they could begin to develop information that will help decision makers formulate rational policy alternatives. Four principal areas of discussion were addressed in the workshop: the current state of knowledge about global climate change and its likely consequences; energy policy options for slowing the expected growth in emissions of greenhouse gases; mitigation measures to cope with the impacts (including impacts related to agriculture and sea-level rise), should they occur, and research needs to assist decision makers in the Pacific and Asia. This volume compiles the proceedings of the workshop. The invited and contributed papers included here are in the form in which they were submitted to the meeting. This volume contains 37 papers. Individual papers are indexed separately on the energy database.

43241 (BNL–44770) **A preliminary ARM [Atmospheric Radiation Measurements] guide for climatic evaluations.** Brown, R.M. Brookhaven National Lab., Upton, NY (USA). Mar 1990. 63p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90015135. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This guide was made to assist in the task of selecting sites for the Atmospheric Radiation Measurements (ARM) study. It is a preliminary attempt to provide mean annual and seasonal meteorological data that might be useful in initial climatic evaluations. It is not a finished product and will be added to in time to give other important information on parameters such as standard deviations, % of means and times, and other variances. In order to cover the spectrum of climatic factors to be considered, this generalized climatic guide was established from various publications to provide a diversified set of basic meteorological data that exists. To comply with other site selection restrictions, this guide covers only the United States, except for the material at the end on Koppens World Climate Classification. It is anticipated that a similar guide will be made to cover the world's climate at a later date. 3 refs., 58 figs.

43242 (BNL–44821) **Acid deposition: No such thing as a free launch.** Schwartz, S.E. Brookhaven National Lab., Upton, NY (USA). Jul 1990. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-9006249–1: The environment: global problems – local solutions, Hempstead, NY (USA), 7-9 Jun 1990). Order Number DE90015085. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper reviews the acid deposition process and outlines the issues of atmospheric science that have made it such a difficult issue on which to achieve consensus. The geographical focus of this review is eastern North America, but the considerations presented here are applicable also to other regions. Acid deposition consists of delivery of acidic substances from the atmosphere to the earth's surface, principally sulfur and nitrogen oxides, acids, and salts.

These compounds (mainly the oxides) are introduced into the atmosphere principally as by-products of fossil fuel combustion. Research on atmospheric processes examines the relations between the rates and spatial distributions of emissions of acidifying substances, the atmospheric concentrations and spatial distributions of these substances and of their atmospheric transformation products, and the rates and spatial distributions of deposition of these materials. The goal of this research is to determine how atmospheric concentrations and deposition fluxes would change in response to specified changes in emissions. Effects research is the study of the consequences of atmospheric concentrations and deposition rates of acidic and related substances on human health, on artificial structural and ornamental materials, on cultivated crops, and on natural terrestrial and aquatic ecosystems. The goal of this research is to determine standards for concentrations and deposition that are suitable for protecting human health and the general welfare from adverse effects of acid deposition. 17 refs., 7 figs.

43243 (CDTN-DERL-PD–007/85) **SKEMA - A computer code to estimate atmospheric dispersion.** Sacramento, A.M. do. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 13 Aug 1985. 22p. (In Portuguese). Order Number DE90635227. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This computer code is a modified version of DWNWND code, developed in Oak Ridge National Laboratory. The Skema code makes an estimative of concentration in air of a material released in atmosphery, by ponctual source. (C.M.).

43244 (CONF-8910434–1) **Chasing a specter: Risk management for global environmental change.** O'Riordan, T. (East Anglia Univ., Norwich (UK)); Rayner, S. Oak Ridge National Lab., TN (USA). Oct 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International workshop on understanding global environmental change; Worcester, MA (USA); 11-13 Oct 1989. Order Number DE90014455. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Global environmental change is both a concept and a process that changes in meaning with scientific discovery, public concern, and political responsiveness. It is the relationship between the problems as perceived and the various institutions that help shape and adapt to such problems that defines global environmental change. There is a kind of race between scientific detective work and political adjustment to lessen the likely impacts that predictive science is trying to verify. Risk analysis, because of its capacity to recognize this relationship in many spheres of problem identification, can contribute to the political debate, mostly by proposing institutional redesign of the relationship among scientific research, public entry, and experimental readjustments to consensus formation and international action. This paper discusses the factors involved in global environmental change, the risk management involved, the holistic interpretation, and the environmental impacts. 21 refs., 5 figs., 5 tabs.

43245 (DTH-LET-RE–90-1-Vol.1) **Influence of lubricating oil on carbohydron emissions from gasoline engines. Part 1: Pilot investigation.** Schramm, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1990. 44p. (In Danish). Contract EM-1243/87-1. Order Number DE90512530. Source: NTIS (US Sales Only), PC A03/MF A01.

EFP-87.

The purpose was to investigate the influence of the lubricant on hydrocarbon emissions from gasoline engines. The influence of the lubricant on fuel consumption and hydrocarbon emissions is described, and is based on a literature study. Experiments were carried out, on a single cylinder engine, with different lubricants and fuels. These were chosen from gas-liquid chromatographic measurements, where the solubility of different fuel components in different lubricants were measured. Two fully synthetic based lubricants were chosen, while isooctane and xylene were chosen as fuels. The lubricant with the lowest solubility with respect to isooctane also showed the lowest hydrocarbon emissions. The influence of the lubricant was greatest at lean air fuel ratios. Xylene is much more soluble in the lubricants than isooctane and gave lower hydrocarbon emissions when the engine was operated at rich air fuel ratios. At leaner mixtures, isooctane gave lower emissions. A model which describes the thermodynamic state as well as hydrocarbon formation and post flame oxidtion in an engine is presented. It succesfully predicts the trends of hydrocarbon emissions obtained by varying the different engine parameters. The predicted effect of changing the lubricant is of the same order of magnitude as found experimentally, but the effect of changing the fuel could not be predicted satisfactorally by the model. A possible explanation to this is that the lubricant film thickness varies due to viscosity variations of the oil film when the fuel is dissolved in the film. Experimental results show a greater influence of the lubricant at leaner air fuel ratios where the lubricant film should be thicker due to a lower amount of fuel dissolved. (AB) 56 refs.

43246 (DTH-LET-RE–90-1-Vol.2) **Influenc of lubricating oil on hydrocarbon emissions from gasoline engines. Part 2: Experiment.** Schramm, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1990. 156p. (In Danish). Contract EM-1243/87-1. Order Number DE90512531. Source: NTIS (US Sales Only), PC A08/MF A01.

EFP-87.

The purpose was to investigate the influence of the lubricant on hydrocarbon emissions from gasoline engines. The influence of the lubricant on fuel consumption and hydrocarbon emissions is described, and is based on a literature study. Experiments were carried out on a single cylinder engines, with different lubricants and fuels. These were chosen from gas-liquid chromatographic measurements, where the solubility of different fuel components in different lubricants were measured. Two fully synthetic based lubricants were chosen, while isooctane and xylene were chosen as fuels. The lubricant with the lowest solubility with respect to isooctane also showed the lowest hydrocarbon emissions. The influence of the lubricant was greatest at lean air fuel ratios. Xylene is much more soluble in the lubricants than isooctane and gave lower hydrocarbon emissions when the engine was operated at rich air fuel ratios. At leaner mixtures, isooctane gave lower emissions. A model which describes the thermodynamic state as well as hydrocarbon formation and post flame oxidation in an engine is presented. It succesfully predicts the trends of hydrocarbon emissions obtained by varing the different engine parameters. The predicted effect of chaning the lubricant is of the same order of magnitude as found experimentally, but the effect of changing the fuel could not be predicted satisfactorily by the model. A possible explanation to this is that the lubricatn film thickness varies due to viscosity variations of the oil film when the fuel is dissolved in the film. Experimental results show a greater influence of the lubricant at leaner air fuel ratios where the lubricant film should be thicker due to a lower amount of fuel dissolved. (AB) 56 refs.

43247 (DTH-LET-RE–90-1-Vol.3) **Influence of lubricating oil on hydrocarbon emissions from gasoline engines. Part 3: Model.** Schramm, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1990. 178p. (In Danish). Contract EM-1243/87-1. Order Number DE90512532. Source: NTIS (US Sales Only), PC A09/MF A01.

EFP-87.

The purpose was to investigate the influence of the lubricatn on hydrocarbon emissions from gasoline engines. The influence of the lubricant on fuel consumption and hydrocarbon emissions is described, and is based on a literature study. Experiments were carried out, on a single cylinder engine, with different lubricants and fuels. These were chosen from gas-liquid chromatographic measurements, where the solubility of different fuel components in different lubricants were measured. Two fully synthetic based lubricants were chosen, while isooctane and xylene were chosen as fuels. The lubricant with the lowest solubility with respect to isooctane also showed the lowest hydrocarbon emissions. The influence of the lubricant was greatest at lean air fuel ratios. Xylene is much more soluble in the lubricants than isooctane and gave lower hydrocabon emissions when the engine was operated at rich air fuel ratios. At leaner mixtures, isooctane gave lower emissions. A model which describes the thermodynamic state as well as hydrocarbon formation and post flame oxidation in an engine is presented. It succesfully predicts the trends of hydrocarbon emissions obtained by varying the different engine parameters. The predicted effect of changing the lubricant is of the same order of

magnitude as found experimentally, but the effect of chaning the fuel could not be predicted satisfactorily by the model. A possible explanation to this is that the lubricant film thickness varies due to viscosity variations of the oil film when the fuel is dissolved in the film. Experimental results show a greater influence of the lubricant at leaner air fuel ratios where the lubricant film should be thicker due to a lower amount of fuel dissolved. (AB).

43248 (DTH-LET-RE–90-2) **Influence of lubricating oil on particle emission from diesel motors.** Schramm, J.; Sorenson, S.C. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1990. 37p. (In Danish). Contract EM-1243/88-5. Order Number DE90512533. Source: NTIS (US Sales Only), PC A03/MF A01.

EFP-88.

Particulates from diesel engines are composed partly of uncombusted carbon (solid state) and partly of solubles, polycyclic aromatic hydrocarbons, (PAH) which are found adsorbed by the solid state substance. PAH is carcinogenetic. Derivatives of PAH which contain nitrogen have proved to be more strongly so. The size of the particulates ($\simeq$ 0,29) make them especially hazardous to health as they stay for a longer time in the system and have a strong tendency to fix themselves in the lungs. Lately it has been found that lubricating oil contributes to particulate emission after the solid substance of the particulate material has been formed, in that lubricating oil is adsorbed on the surface of the solid state part of the particulate emission. About half of the soluble part of the particulate material seems to stem from the lubricating oil, the amount varies from one engine to another. The contribution of lubricating oil also varies with respect to the size of the emitted paticulates. The average contribution seems to be 10-15%. It is thus concluded that lubricating oil contributes significantly to PAH emission even though it does not contain much PAH itself. It becomes polluted with PAH from the fuel after about 100 hours of driving. It appears to function as a sort of PAH storage medium in that the PAH content of the particulate material increases according to the number of driving hours after the oil is changed. It seems that fuel and PAH is dissolved in the lubricating oil in accordance with the amount of PAH given off by the lubricating oil to the particulate material. (AB) 30 refs.

43249 (GSF–3/90) **Is the greenhouse effect a problem of the 21st century?. Proceedings.** Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. 151p. (In German, English, French). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

The Gesellschaft fuer Strahlen- und Umweltforschung (GSF), Munich, the German-French Society for Science and Technology (DFGWT/AFAST) Bonn/Paris, and the Working Group of Large Research Institutions (AGF), Bonn, convened a German-French symposium on the subject: 'The greenhouse effect - a problem of the 21st century.', held at GSF, Neuherberg, on December 13 and 14, 1988. At the German-French level the question was to be discussed of how immediate the global threat to our climate is. The symposium was above all to aid communication between science and politics; at the same time, the state of knowledge was pointed out and appraised. (orig.).

43250 (GSF–3/90, pp. 1-20) **The greenhouse effect and its intensification by changing concentrations of atmospheric trace gases.** Fischer, H. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In German). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

A precondition for understanding the greenhouse effect is the determination of the part played by trace gases in the radiation balance of the system earth/atmosphere. Such knowledge shows changing concentrations of atmospheric trace gases to entail a modification of the radiation balance and, thus, the greenhouse effect. Said changes in concentrations have been proved beyond doubt for trace gases with a long retention time in the atmosphere. Spectral analysis of the radiation effects in the atmosphere caused by the changes of concentration of trace gases yields qualitative information rendering the greenhouse effect understandable. Detailed radiation transfer calculations permit relatively precise quantification of effects in the radiation flows. Uncertainties exist mainly because of limited accuracy with regard to the future development of trace gas concentrations in the atmosphere. Climate models permit to predict the future state of the atmosphere taking into account these changes in the radiation flows. The calculated climate changes are still fraught with a number of uncertainties, though, as models have not been able so far to consider back-coupling effects adequately. (orig./KW).

43251 (GSF–3/90, pp. 21-28) **The carbon cycle.** Lambert, G. (Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Centre des Faibles Radioactivites). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In French). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

The general concern about the atmospheric CO_2 is due to its increase from 280 ppm in 1800, to 350 ppm in 1988, mainly ascribed to imbalanced human activities. However, the global atmospheric CO_2 concentration also displays other poorly accounted for changes. Seasonal variations are mainly controlled by the vegetation cycle. Irregular fluctuations seem to be associated to temporary phenomena such as the El Nino-Southern Oscillation (ENSO). Important gaps occurred at the beginning and the end of ice ages. All these variations are obviously due to strength changes of various sources and sinks of atmospheric CO_2, among them only the fossil fuel use is well documented. There is considerable doubt about whether the current CO_2 exchange estimates represent the net flux of carbon between marine and terrestrial systems (including deforestation) and the atmosphere, or whether there are other sources and sinks from changes in oceans circulation patterns, and undisturbed continental areas, for example from climate or CO_2 fertilisation effects. The available data on present and past variations suggest the existence of natural feedback components, which could be essential in understanding changes in carbon cycle, and its climatic consequences, over the next century. (orig.).

43252 (GSF–3/90, pp. 29-58) **CO_2: The search for the signal.** Santer, B.D. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany, F.R.)). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

Studies which have attempted to detect the climatic signal associated with increasing atmospheric levels of CO_2 rely on experimental results from General Circulation Models (GCMs) for definition of the signal. The purpose of this investigation is to examine the similarities and differences in the results yielded by recent GCMs for the equilibrium response to CO_2 doubling. The three atmospheric GCMs considered are of comparable horizontal and vertical resolution, and all are coupled with simple mixed-layer ocean models. Examination of the simulated temperature changes ($2xCO_2$ minus $1xCO_2$) at the surface and in the vertical structure of the atmosphere reveals a number of important similarities. These include poleward amplification of the surface temperature change (ΔT_s) in the winter hemisphere, large seasonal variation in ΔT_s poleward of 50deg latitude in both hemispheres, stratospheric cooling above 20 km, and tropospheric warming. The changes in precipitation rate simulated by all three models are generally positive poleward of 30deg latitude (in both summer and winter). These responses are physically interpretable, for example in terms of ice-albedo feedbacks and the temperature dependence of saturation

vapor pressure. For both temperature and precipitation changes, inter-model agreement is better for zonal averages than for geographical distributions. At the current stage of model development, it may be advisable to use zonal average changes for multivariate CO_2 detection studies. (orig./KW).

43253 (GSF–3/90, pp. 59-91) **The future height of the sea level.** Oerlemans, J. (Rijksuniversiteit Utrecht (Netherlands). Inst. voor Meteorologie en Oceanografie). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In German). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

The paper tests proofs for the assumption that the sea-level will rise more quickly in case of a heating of the climate. Within a time-period ranging from decades to centuries, four processes seem to be prevalent: melting of mountain glaciers and small ice caps, changes in the mass bill of the large polar ice sheets (Greenland, Antarctica), a possible instability in the ice run-off of the West-Antarctic ice sheet, and thermal expansion of the sea-water. For a given temperature scenario, the paper attempts to assess the individual contributions of these factors. The calculation indicates a rise of the sea-level by 9.5 centimeters since 1850; this is not substantially below the 'observed' rise. A further rise by 33 centimetres is established as highly probable for the year 2050; yet this number is based on considerable uncertainties (s = 57 cm). The estimated values of the standard deviatio n take into account the uncertainty in the temperature scenario. (orig.).

43254 (GSF–3/90, pp. 93-101) **Greenhouse effect and redistribution of climate.** Sadourny, R. (Ecole Normale Superieure, 91 - Palaiseau (France). Lab. de Meteorologie Dynamique). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In French). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

The increase in the portion of greenhouse effect gases in the earth atmosphere expected for the middle of the next century is claimed to cause on increase in the temperature of the lower layers of the atmosphere by 2 to 5deg. A more accurate forecast of this average increase in temperature will be possible only when more reliable, coupled models ocean/atmosphere will be much more advanced than today; and this holds true even more of the forecasting of new regional climate changes. Efforts to devise models should concentrate, besides the ocean cycle, mainly on the more precise description of all aspects of the water cycle and concomtant mechanisms: For this it is particularly important to achieve a realistic simulation of clouds and their optical properties and a realistic representation of the effects of vegetation and soil types on the water and energy balance of the continents. (orig.).

43255 (GSF–3/90, pp. 103-112) **Consequences of an increase in the greenhouse effect and their regionalization.** Bolle, H.J. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Meteorologie). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In German). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

Research on climate effects is still in its initial stage, even where judgements of effects at a first level are concerned. On the basis of one or more given scenarios and known experimental data on the behaviour of plants under changing environmental conditions, the paper for one thing determines the shifts of vegetation zones of plant populations and, for another, assesses the changes in crop yields. The back-coupling processes mentioned, if taken into account at all, are so in a very general manner only, or dealt with in theoretical models. As to the reaction of man to climate changes there merely exist suppositions. (orig.).

43256 (GSF–3/90, pp. 123-134) **Strategies for a reduction of CO_2-production.** Seeliger, J. (Gesamtverband des Deutschen Steinkohlenbergbaus, Essen (Germany, F.R.)). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In German). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

The author describes the problem of the greenhouse effect from the viewpoint of the German black-coal mining industry. First of all, the state of climate research in this sector and the energy-economic starting situation are described. A precautionary strategy to reduce CO_2 emissions is proposed. It comprises enhanced energy-use efficiency, promotion of renewable energy sources, checking of fire clearing of forests, and - in a second stage - substitution of fossil energy sources by energies free of CO_2. This includes nuclear energy, subject to provision being made for radioactive waste disposal. All steps must be internationally concerted in order to be effective. At the same time, emission of other gases bearing on climate must be reduced. (KW).

43257 (GSF–3/90, pp. 135-148) **The greenhouse effect: The need for research and promotion.** Krause, P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1990. (In German). (CONF-8812142–: German-French colloquium: is the greenhouse effect a problem of the 21st century, Neuherberg (Germany, F.R.), 13-14 Dec 1988). In *Is the greenhouse effect a problem of the 21st century?. Proceedings.* Order Number DE90512927. Source: NTIS (US Sales Only), PC A08/MF A01.

Discussions in the advisory bodies of the Federal Ministry of Science and Technology (circle of experts, expert committees), but also hearings and discussions in the inquiry commission 'Precautions to Protect the Earth Atmosphere' of the German Bundestag, and the first interim report of this commission, presented not long ago, have shown that only better understanding of the interactions between atmosphere, ocean, and biosphere will allow more specific statements. Herein the following essential tasks have emerged: - quantification of the sources and sinks of climate-relvant trace gases, - coupling of models of atmosphere, ocean biosphere, and cryosphere, - reaction of the atmospheric water cycle to increased trace gas concentrations. Four different approaches are adopted: - long-term observation of trace gas concentrations and climate parameters, - intensive measuring phases to elucidate certain processes, - further development of numerical models, - search for the anthropogenic contribution to climate change. (orig./KW).

43258 (IAEA-TECDOC–550, pp. 43-54) **Long term worldwide environmental effects caused by acid rain from fossil fuels.** Manowitz, B. (Brookhaven National Lab., Upton, NY (USA). Dept. of Applied Science); Lipfert, F.W. International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Acid rain is regarded as an environmental problem of growing importance in many parts of the world; it is one of the adverse effects of air pollution. This paper presents data on emissions of air pollutants from combustion of fossil fuels and discusses atmospheric processes that act on these emissions, various effects of air pollution and acid deposition, and some of the aspects of regulation of these pollutants. Evidence of worldwide concern is shown by contrasting the perceived adverse effects of air pollution with ambient levels and the status of regulation. (author). 25 refs, 3 figs, 3 tabs.

43259 (IAEA-TECDOC–550, pp. 33-42) **The greenhouse effect and global climate change.** Morel, P. (World Meteorological Organization, Geneva (Switzerland)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

The ongoing increase in the concentration of infrared-absorbing gases in the atmosphere is already causing and will continue to cause a growing imbalance in the radiation budget of the earth, and consequent warming of the lower atmosphere and earth surface. This climate phenomenon is the manifestation of the greenhouse or blanketing effect of absorbing gases (also known as "greenhouse gases") in the earth atmosphere. The main chemical species responsible for the build-up of the greenhouse effect are carbon dioxide, methane and chlorofluorocarbons (CFCs) or freons. Despite new regulatory efforts made by governments to slow down the emission of these gases, the combined atmospheric burden could be equivalent to doubling the pre-industrial concentration of carbon dioxide ($2xCO_2$) by the middle of next century. The global warming of the earth surface would eventually reach about 4 deg. C if the $2xCO_2$ concentration then was maintained constant for a long period. As it is, the transient response of climate to an increasing greenhouse effect is delayed by 50 to 100 years. For this reason, we observe now a much smaller climate warming than would occur for climate equilibrium with the present atmospheric composition, i.e. 125% the pre-industrial concentration of CO_2. Impacts of this phenomenon will range from disturbances of the existing hydrological regime of the planet to rise of the global mean sea-level. A warmer atmosphere means more rain but also faster evaporation: consequences in terms of the availability of water resources are unclear at temperate and high latitudes, but an aggravation of aridity in sub-tropical latitudes is probable. Sea-level rise may reach 50 cm by 2100. In general, the rate of climate warming when the climate system starts responding to the greenhouse effect could be 0.3 deg. C per decade, far exceeding the ability of natural ecosystems to adapt effectively to the change.

43260 (INP–1400/B) **Long lived isotopes in the Chernobyl radioactive cloud at Cracow.** Mietelski, J.W.; Broda, R.; Sieniawski, J. Institute of Nuclear Physics, Cracow (Poland). 1988. 15p. Order Number DE90635228. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The analysis of the residual gamma radioactivity in the air filters exposed during the passage of the Chernobyl radioactive cloud over Cracow area gave data on variation in time of the relative contribution of long lived radioisotopes. Conclusions on transport properties of some elements are deduced from the obtained results. 10 refs., 5 figs. (author).

43261 (ISI-B–31-88) **Cost efficiency analyses and optimization of measures for emission and air pollution abatement. Final report.** Jochem, E.; Mannsbart, W.; Schoen, M. Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung (ISI), Karlsruhe (Germany, F.R.); Deutsche Forschungsgemeinschaft, Bonn (Germany, F.R.). Dec 1988. 85p. (In German). Contract DFG Jo 100/5-1. Order Number DE90512823. Source: NTIS (US Sales Only), PC A05/MF A01.

A method for the determination of the macroeconomically most cost-efficient measures for the reduction of air pollution abatement in a representative model area (city of Karlsruhe) is described. The linear optimation model used here describes technologies of power and district heat generation, mineral or processing, generation of low-temperature heat, road transport, technologies for the reduction of emissions through specific costs, energy consumptions and (residual) pollutant emission. The specific contribution of these technologies to the immission is described with a Gauss' propagation model. Source-specific data like sites of power stations or area sources (domestic heating, road traffic) are given. Several jointly occurring air pollutants are weighted with the limit values of immissions in order to obtain an immission index. It can be calculated at what cost to carry out which measure in order to reduce immissions caused by energy conversion and -consumption in the model area. Price-related changes in the energy demand caused by rising costs of environmental protection can be included in the calculations. First results show that reducing the emissions from road traffic is immensely important. Increasing energy prices in the wake of stricter environmental regulations lead to a reduced energy consumption and indirectly reduce immission. The project was financed with funds from the German Research Association (Deutsche Forschungsgemeinschaft, DFG). (orig.).

43262 (IVL-B–950) **Emissions of carbon dioxide. A comparison between biomass fuels and natural gas.** Calander, K.; Gustavsson, K.; Pleijel, H. Swedish Environmental Research Inst., Goeteborg (Sweden). Jun 1989. 39p. (In Swedish). Order Number DE90512613. Source: NTIS (US Sales Only), PC A03/MF A01.

A study was made for comparing biomass fuels with natural gas combustion in combination with various land utilization alternatives, in respect of emission and take-up of carbon dioxide. In the long run will all combustion of fossil fuels that is beyond the natural new formation of them involve a net contribution of carbon dioxide to the atmosphere. Combustion together with growing of biomass fuels means in the long run neither a net contribution or a take-up of carbon dioxide for the atmosphere. However a lesser addition will occur if biomass fuels are handled by fossil driven vehicles (corresponding to about 1% of the emissions from a natural gas fueled combined power and district heating plant). Our estimates show that natural gas combustion combined with reforestation of an area corresponding to what would have been needed to supply the plant with straw fuel, implies a net emission of carbon dioxide up to about 50 years. After that a net take-up of carbon dioxide for the atmsophere takes place up to between 100-200 years. Reforestation of the area needed for a corresponding supply of forest energy, will on the other hand not be sufficient for compensation of the emission from the nature gas fueled combined power and district heating plant. A change of land utilization from an ecosystem with a large amount of organic carbon to a system with a less amount will for a period of time represent a net emission of carbon dioxide for the atmosphere. To accomplish a take-up of CO_2 from the atmosphere a good or better alternative of i.e. reforestation of an area under cultivation might be to prevent an existing ecosystem with a large amount of organic carbon (i.e. a virgin forest or a wetland) from being transformed into an ecosystem with less bound carbon. (16 figs., 2 tabs., 16 refs.).

43263 (Juel-Spez–525) **Determining the factors of emission in the production of materials.** Angewandte Systemanalyse. Wagner, H.J.; Wassmann, B.; Hansen, K.; Schoen, R. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; EST Gesellschaft fuer Energiesystemtechnik mbH, Essen (Germany, F.R.). Oct 1989. 80p. (In German). Order Number DE90510202. Source: NTIS (US Sales Only), PC A05/MF A01.

The emission of pollutants from the use of energies is determined by means of analysing the specific energy consumption of the individual phases in the production of aluminium, copper, steel, concrete, flat glass and plastics for casings. The specific pollutant production of an energy is calculated from the material on the specific energy use in the individual phases of a process and a representative structure of energies as well as emission factors resulting from the use of energy. It is not only the energies that cause emissions but also the production methods and the materials used there in. These are defined and calculable on the one hand but undefined (emissions from leakages etc.) and incalulable on the other hand. Selected calculations demonstrate the use of operable parameters for certain materials. Specific emission data are determined. (orig./EF).

43264 (KFK–4698) **Retrieval of stratospheric trace gas profiles from infrared limb emission spectra.** Clarmann, T. v. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik. Mar 1990. 126p. (In German).

Order Number DE90510279. Source: NTIS (US Sales Only), PC A07/MF A01.

A computer code is presented for the inverse solution of the equation of radiative transfer. It was developed for retrieving mixing ratio profiles form atmospheric infrared spectra. This software is comaptible to the requirements of the MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) balloon experiment. It is applicable to a sequence of emission spectra which are measured in limb sounding mode at different nadir angles. Adjusting atmospheric parameters is done either by nonlinear least squares fit or by the application of the heteromorphic coefficient. Several fitting procedures have been intercompared for different atmospheric spectra. Furthermore an intercomparison has been carried out for retrieval methods which are commonly used for evaluation of limb sounding data: Onion peeling, Mill-Drayson method and global fit. Onion peeling proves to be superior for most applications which are expected to occur when evaluating MIPAS data. The user of this software package may combine fitting and retrieval algorithms in order to optimize the speed and accuracy of the retrieval according to the actual problem. Criteria for the selection of algorithms are: Grade of saturation of spectral lines, signal/noise ratio of the measurements, number of unknown parameters, reliability of a priori information, available computer time. (orig./KW).

43265 (ORNL/FTR–3694) **[CO_2-containment strategies]: Foreign trip report, July 14, 1990–July 21, 1990.** Fulkerson, W. Oak Ridge National Lab., TN (USA). 8 Aug 1990. 67p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90015378. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This trip was partially paid for by Resources for the Future to obtain Dr. Fulkerson's participation in a conference in Tokyo considering the issue of international agreements between nations on controlling CO_2 emissions. The traveler also visited the Japan Atomic Energy Research Institute's JT-60 site at Naka-machi, the National Institute for Fusion Science of Monbusho at the University of Nagoya, and the Maekawa Electric Steel Casting Company, Ltd. (MESCO) at Osaka. Japan is taking the global climate issue most seriously, and that interest is reflected already in official energy projections by the Ministry of International Trade and Industry (MITI) and the New Earth 21 vision of an ecological sustainable world. MITI's focus is on better energy technologies, and the institutions for promoting adoption of that ecological sustainable world. Construction of JT-60 is headed for operation in March of 1991, and Japan is pushing a neutron source for fusion called the Energy Selective Neutron Irradiation Test Facility to be built at the Oarai site where the 30-MW HTGR for process heat will also be built. The funding for the Large Helical Device has been approved and work is in progress at the new Toki site. Collaboration with ORNL on ATF steady-state operation has been officially proposed, but funding is not yet approved. MESCO is a foundry making high-quality, specialized steel castings in Osaka and Kyushu. They have a joint venture with China to transfer Japanese skills. 28 refs., 4 figs., 4 tabs.

43266 (PB–90-204744/XAB) **National Radon Contractor Proficiency (RCP) program: Proficiency report.** Salmon, G.L. Office of Radiation Programs, Washington, DC (USA). Apr 1990. 115p. (EPA–520/1-90/004). Source: NTIS, PC A06/MF A01.

The report lists those individual contractors who have met the requirements of the Radon Contractor Proficiency (RCP) Program as of February 1, 1990. These requirements are designed to provide minimum proficiency criteria for individuals who design and supervise the installation of radon mitigation systems in buildings.

43267 (PB–90-216391/XAB) **Some results from the demonstration of indoor radon-reduction measures in block-basement houses.** Henschel, D.B.; Scott, A.G. American ATCON, Inc., Wilmington, DE (USA). ©1989. 8p. Source: NTIS, PC A02/MF A01.

Pub. in Environment International, Vol. 15, 265-270(1989). See also PB–87-176426.

The paper gives results of tests of active soil ventilation techniques in 24 block-wall basement houses in eastern Pennsylvania having significantly elevated indoor radon concentrations, generally above 740 Bq/cu m. The results indicate that radon levels can be reduced substantially (often below the U.S. EPA guideline of 148 Bq/cu m) if effective suction can be drawn on the soil underneath the concrete slabs of these houses. Such effective suction appears achievable when either: (1) the house has a complete loop of drain tile around its footings for water drainage purposes, and suction is drawn on that loop; or (2) a sufficient number of suction pipes can be inserted at the proper locations into the crushed rock or soil underneath the slab.

43268 (PB–90-217399/XAB) **Mutagenic atmospheric aerosol sources apportioned by receptor modeling.** Stevens, R.K.; Lewis, C.W.; Dzubay, T.G.; Baumgardner, R.E.; Zweidinger, R.B. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. ©1990. 12p. (EPA–600/J-90/005). Source: NTIS, PC A03/MF A01.

Pub. in ASTM (American Society for Testing and Materials) STP-1052, Monitoring Methods for Toxics in the Atmosphere, 187-196(1990).

During winter 1985 EPA collected air quality samples and data in residential locations in Albuquerque, NM and Raleigh, NC as part of its Integrated Air Cancer Project. Major objectives of the study were to evaluate new sampling, analysis and receptor modeling procedures and to apportion fine particle mass and mutagenic activity of the organic fraction of fine particles to appropriate sources. Samples were collected in the two cities for 12-hour periods beginning at 7:00 am and 7:00 pm. The schedule was followed to aid in resolving the organic and inorganic chemical species emitted from residential wood burning (normally a night time activity) and from mobile source emissions. Samples were analyzed for mutagenicity, organic carbon, 14C content and inorganic species. Data from these analyses served as input to a multi-linear regression (MLR) model that calculates the relative contribution of extractable particulate organic matter and mutagenic activity observed in these two cities. The ^{14}C results were used to validate the MLR model. Even though the monitoring sites in these cities, were both selected and found to be heavily impacted by residential wood burning (83% & 94% of the organic aerosol mass due to wood burning), a proportionately larger % of the mutagenicity of the fine particles was attributed to mobile sources (25 and 37%).

43269 (PB–90-219700/XAB) **Radon mitigation in schools: Case studies of radon mitigation systems installed by EPA in four Maryland schools are presented.** Saum, D.; Craig, A.B.; Leovic, K. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. ©1990. 8p. (EPA–600/J-90/010). Source: NTIS, PC A02/MF A01.

Pub. in American Society of Heating, Refrigeration and Air Conditioning Engineers Jnl., Vol. 32, No. 2, 20-25(Feb 1990). See also PB–90-219718.

The first part of the two-part paper discusses radon entry into schools, radon mitigation approaches for schools, and school characteristics (e.g., heating, ventilation, and air conditioning – HVAC – system design and operating) that influence radon entry and mitigation system design. The second part discusses specific mitigation systems that were installed by the U.S. EPA in four Maryland schools. HVAC systems in schools vary considerably and tend to have a greater impact on pressure differentials; and consequently on radon levels than do heating and air conditioning systems in houses. If the HVAC system induces a negative pressure relative to the subslab area, radon can be 'pulled' into the building. If the HVAC system pressurizes the building, it can prevent radon entry as long as the fan is running. However, school HVAC systems are normally set back or turned off on evenings and weekends and, even if the HVAC system pressurizes the school during operation, indoor radon levels may build up during the setback periods.

43270 (PB–90-219718/XAB) **Radon mitigation in schools: HVAC systems in schools tend to have a greater impact on radon levels than HVAC systems in homes.** Leovic, K.W.; Craig, A.B.; Saum, D.W. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. ©1990. 6p. (EPA–600/J-90/009). Source: NTIS, PC A02/MF A01.

Pub. in American Society of Heating, Refrigeration and Air Conditioning Engineers Jnl., Vol. 32, No. 1, 40, 42, 44, 45(Jan 1990). See also PB–90-219700.

The first part of the two-part paper discusses radon entry into schools, radon mitigation approaches for schools, and school characteristics (e.g., heating, ventilation, and air-conditioning–HVAC–system design and operating) that influence radon entry and mitigation system design. The second part discusses specific mitigation systems that were installed by the U.S. EPA in four Maryland schools. HVAC systems in schools vary considerably and tend to have a greater impact on pressure differentials–and consequently on radon levels–than do heating and air-conditioning systems in houses. If the HVAC system induces a negative pressure relative to the subslab area, radon can be 'pulled' into the building. If the HVAC system pressurizes the building, it can prevent radon entry as long as the fan is running. However, school HVAC systems are normally set back or turned off on evenings and weekends and, even if the HVAC system pressurizes the school during operation, indoor radon levels may build up during the setback periods. The primary mode of radon entry into a school with significantly elevated radon levels is normally from soil gas that is drawn in by pressure differentials between the soil surrounding the substructure and the building interior.

43271 (PB–90-220492/XAB) **Background information document: Procedures approved for demonstrating compliance with 40 CFR Part 61, Subpart I.** Office of Radiation Programs, Washington, DC (USA). Oct 1989. 140p. (EPA–520/1-89/001). Source: NTIS, PC A07/MF A01.

The purpose of the document is to provide information supporting the procedures developed for NRC-licensed and non-DOE Federal facilities to use in demonstrating compliance with the radionuclides NESHAP (National Emission Standards for Hazardous Air Pollutants) (40 CFR 61, Subpart I). Specifically, the Background Information Document has the following objectives: to provide the basis for the calculational and analytical methods approved for determining emissions; and to provide the basis for the procedures approved for demonstrating compliance with the dose limits of the standard. Particular emphasis is given to the derivation and use of emission factors to estimate the quantities of material handled that become airborne and to the adjustment factors for effluent controls, which may be applied to the quantities to estimate emissions. Within the restrictions given, these emission factors and effluent control adjustment factors may be used in lieu of measured release rates in determining compliance with the standard.

43272 (PB–90-221953/XAB) **Radon mitigation effects of passive stacks in residential new construction. Report for December 1989-February 1990.** Saum, D.W.; Osborne, M.C. Infiltec, Falls Church, VA (USA). ©1990. 9p. Source: NTIS, PC A02/MF A01.

The paper discusses the effects of passive stacks in mitigating radon levels in residential new construction. Although passive stacks have been installed as a radon resistant measure in new houses, little quantitative data on their performance has been collected. The study involved continuously monitoring several houses that were recently built with radon resistant features including crack sealing, porous subslab aggregate, and a stubbed-off pipe penetrating the slab for installing a radon mitigation system. For the project, the piping systems were completed so that they exited the roof, and half the houses had radon mitigation fans installed in the piping. Houses were monitored continuously with the pipes sealed, then with the pipes open but no fans operating, and finally with the fans (if installed) operating. The results show significant radon mitigation effect by the passive stack systems in most houses. Failures of the passive stack systems appear to be due to basement depressurization by heating, ventilation, and air-conditioning (HVAC) duct leakage, poor installation of subslab piping, and poor communication between multilevel slabs.

43273 (PB–90-872300/XAB) **Stack disposal and reduction of radioactive gaseous effluents. October 1975-May 1990 (A Bibliography from the NTIS data base). Report for October 1975-May 1990.** National Technical Information Service, Springfield, VA (USA). Jun 1990. 104p. Source: NTISPC N01/MF N01.

This bibliography contains citations concerning the release and dilution of radioactive gaseous waste, via chimney or stack disposal, into the atmosphere. Topics include modeling of exhaust plumes, deposition and environmental impacts, measurement, analysis, and monitoring of gas wastes and aerosols. Articles refer to monitoring data from a variety of nuclear facilities including power reactors, experimental reactors and laboratories, and nuclear processing plants. Solid and liquid radioactive waste disposal is referenced in related published bibliographies. (Contains 175 citations fully indexed and including a title list.)

43274 (RISO-M–2754) **Atmospheric heavy metal deposition in Denmark, Iceland, Greenland and Northern West Germany 1985 - monitored by moss analysis.** Pilegaard, K.; Rasmussen, L. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Mar 1989. 57p. (In Danish). Order Number DE90509408. Source: NTIS (US Sales Only), PC A04/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

The atmospheric heavy metal deposition in northern Europe, including Denmark, Finland, Norway, Sweden, Greenland, Iceland, Svalbard and Northern West Germany, was monitored in 1985 by means of moss as the monitoring organism. The present report gives details of the results from Denmark, Greenland, Iceland and Northern West Germany. Samples of the moss Pleurozium schreberi have been collected and analyzed for As, Cd, Co, Cu, Fe, Ni, Pb, V and Zn. The results show that for most heavy metals the concentration levels are highest in the southern and eastern parts of the country. On a European scale no "high emission" areas were found in Denmark. There was no significant difference between theconcentration levels in Denmark and Northern West Germany. Metals mainly originating from anthropogenic emission sources (Cd, Pb and Zn) were found at higher concentration levels in Denmark than in Greenland and Iceland, whereas the opposite was true for the metals mainly originating from soil dust and volcanic activity. In comparison with the similar survey from 1980, it was found that the concentrations of metals mainly originating from oil combustion have decreased, whereas the levels for metals emitted by coal combustion have increased. In spite of the fact that traffic has increased during the five year period, a small decrease in Pb concentrations was found in 1985 in comparison with 1980. This decrease can be referred to the reduction of Pb in petrol. (author) 8 tabs., 50 ills., 5 refs.

43275 (RISO-M–2816) **Occurrence of polycyclic aromatic hydrocarbons (PAH) at the international airport of Copenhagen.** Nielsen, T.; Pilegaard, K. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Feb 1990. 82p. (In Danish). Order Number DE90509409. Source: NTIS (US Sales Only), PC A05/MF A01; Also available from Risoe Library, DK-4000 Roskilde.

The presence of PAH is investigated in the neighbourhood of the international airport at Copenhagen. The investigation includes vapor-phase PAH as well as particle-adsorbed PAH. The air pollution is estimated at two locations and compared with that at other locations. The annual average of benzo(a)pyrene at the airport terminal is estimated to be in the magnitude of 2 ng/m3. The sources are traffic and combustion, including long distance transport. The contribution of the car traffic at the airport terminal is estimated to be not higher than 15 +- 20% and that from air traffic less than 8% of the total contribution. The composition of the PAH varies with the composition of the soruces. A considerable part of the lighter PAH, e.g. phenanthrene, is present in vapor phase. The distribution between vapor-phase and particle-adsorbed is dependent of the ambient temperature and the concentration of soot particles. Only a small part of the carcinogenic PAH is in vapor phase. The air pollution of PAH correlates with the air pollution of mutagenic compounds, particles, NO, NOy, CO, SO2 and hydrocarbons. (author) 13 tabs., 10 ills., 68 refs.

43276 (SERI/TP–260-3772) **CO_2 emissions from coal-fired and solar electric power plants.** Keith, F.; Norton, P.; Brown, D. Solar Energy Research Inst., Golden, CO (USA). May 1990. 44p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000337. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents estimates of the lifetime carbon dioxide emissions from coal-fired, photovoltaic, and solar thermal electric power plants in the United States. These CO_2 estimates are based on a net energy analysis derived from both operational systems and detailed design studies. It appears that energy conservation measures and shifting from fossil to renewable energy sources

have significant long-term potential to reduce carbon dioxide production caused by energy generation and thus mitigate global warming. The implications of these results for a national energy policy are discussed. 40 refs., 8 figs., 23 tabs.

43277 (STEV-FBT–90-S) **Emissions from small-scale wood firing - comparison of testing methods.** Karlsson, M.L. (Statens Provningsanstalt, Boraas (SE)). Statens Energiverk, Stockholm (Sweden). 1990. 54p. (In Swedish). Project STEV-276-359. Order Number DE90512616. Source: NTIS (US Sales Only), PC A04/MF A01.

A study of the correlation between the American and the Swedish test method regarding emissions from two central heating boilers and a wood stove has been carried out. In the Swedish method, SP-METOD 0010, the samples of emission are taken directly in the chimney. The American method, EPA Method 5G, however makes use of a diluting tunnel, where the flue gas is mixed with the air in the room. Samples of the emission are then taken in the tunnel. In this study also samples according to the Swedish method have been taken in the diluting tunnel. The tests were carried out on: * a central heating boiler with over-firing, * a central heating boiler with under-firing, * a wood stove. As expected, it turned out that the boiler with over-firing caused high emissions of dust and tar. This led to problems with clogged filters in the American method, and made a comparison between the methods in this respect impossible. The boiler with under-firing and the wood stove, however caused low emissions. Tests according to the American method could therefore be carried out. In total six tests, with simultaneous sampling according to the American method, the Swedish method, and the Swedish method with sampling in the chimney, have been carried through. The results show no correlation between the methods whether the sampling, according to the Swedish method, was made in the chimney or in the diluting tunnel. Besides, it turned out that a higher value according to the American method did not always correspond to a higher value according to the Swedish one. Furthermore, two of the tests indicated a higher content of tar in the tunnel than in the chimney.

43278 (UCRL–102141) **A comparison of the Monte Carlo and the flux gradient method for atmospheric diffusion.** Lange, R. Lawrence Livermore National Lab., CA (USA). May 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900534–3: 18. NATO/CCMS international technical meeting on air pollution modelling and its applications, Vancouver (Canada), 13-17 May 1990). Order Number DE90015040. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order to model the dispersal of atmospheric pollutants in the planetary boundary layer, various methods of parameterizing turbulent diffusion have been employed. The purpose of this paper is to use a three-dimensional particle-in-cell transport and diffusion model to compare the Markov chain (Monte Carlo) method of statistical particle diffusion with the deterministic flux gradient (K-theory) method. The two methods are heavily used in the study of atmospheric diffusion under complex conditions, with the Monte Carlo method gaining in popularity partly because of its more direct application of turbulence parameters. The basis of comparison is a data set from night-time drainage flow tracer experiments performed by the US Department of Energy Atmospheric Studies in Complex Terrain (ASCOT) program at the Geysers geothermal region in northern California. The Atmospheric Diffusion Particle-In-Cell (ADPIC) model used is the main model in the Lawrence Livermore National Laboratory emergency response program: Atmospheric Release Advisory Capability (ARAC). As a particle model, it can simulate diffusion in both the flux gradient and Monte Carlo modes. 9 refs., 6 figs.

43279 (UCRL-CR–104490-Exe.Summ.) **Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition: Executive summary: Final report.** Penner, J.E.; Atherton, C.S.; Walton, J.J. Lawrence Livermore National Lab., CA (USA). Jul 1990. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015401. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nitrogen oxides are important for global photochemistry because they determine whether O_3 is produced or destroyed. In this paper, we describe our simulations of the global cycle of reactive nitrogen. We use a three-dimensional chemistry-transport-deposition model. Our model is a Lagrangian model in which trace species react and are carried in constant-mass air parcels; the parcels are advected by winds calculated by the NCAR Community Climate Model (CCM), a nine-layer general circulation model. In Section 2, we describe the model, together with our specification of the reactive nitrogen sources. A comparison of our predicted concentrations and deposition amounts with measurements appears in Section 3. Section 4 describes our model results for predicted distributions, while Section 5 describes our results for deposition. Section 6 summarizes a regional analysis of sources and deposition. Our conclusions appear in Section 7. 42 refs., 9 figs., 5 tabs.

43280 (UCRL-JC–104052) **The global cycle of reactive nitrogen.** Penner, J.E. (Lawrence Livermore National Lab., CA (USA)); Atherton, C.S.; Walton, J.J.; Hameed, S. Lawrence Livermore National Lab., CA (USA). Jun 1990. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9005252–1: International conference on global and regional environmental atmospheric chemistry, Beijing (China), 3-10 May 1990). Order Number DE90015041. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have simulated the global cycle of reactive nitrogen in a three-dimensional chemistry-transport-deposition model. Our model is a Lagrangian parcel model in which trace species react and are carried in constant-mass air parcels; the parcels are advected by winds calculated by an atmospheric general circulation model (GCM). The GCM calculated winds, clouds, precipitation and other variables at nine levels in the atmosphere with a horizontal resolution of approximately 4.5° latitude and 7.5° longitude. The model includes the basic chemical reactions of NO, NO_2, and HNO_3 calculated with prescribed distributions of OH and O_3. The model predicts atmospheric concentrations of NO_x (NO + NO_2) and HNO_3 throughout the globe at nine altitudes. In addition, deposition of nitrogen in precipitation and in dry processes is also calculated. We present global maps of calculated atmospheric concentration with emphasis on the surface atmospheric concentration of NO_x. Comparisons between calculated and observed atmospheric concentrations and deposition rates are made for several parts of the world. The long-range transport of NO_x is documented from the model by comparing the ratio of surface NO_x concentrations for all sources to those for natural sources only. 40 refs., 6 figs., 2 tabs.

43281 Time-averaged exposures to ^{220}Rn and ^{222}Rn progeny in Colorado homes. Martz, D.E. (Department of Energy, Grand Junction Projects Office, CO (USA)); Falco, R.J.; Langner, G.H. Jr. *Health Physics (USA)*, 58(6): 705-713 (Jun 1990).

Week-long time-averaged exposures to naturally occurring ^{220}Rn and ^{222}Rn progeny have been measured at several locations in Colorado by monitoring the alpha activity collected continuously on a fixed-membrane filter. The alpha-energy spectrum associated with the activity collected on the filter was recorded every 15 min using a microcomputer-controlled alpha spectrometer. The alpha counts observed in three energy regions permitted complete separation of the contributions from each decay chain, and calculation of the separate time-averaged potential alpha-energy concentrations in air from ^{220}Rn progeny, PAEC(Tn), and from ^{222}Rn progeny, PAEC(Rn). The time-averaged PAEC(Tn) ranged from 0.3 to 6.9 mWL at 12 indoor locations, and the time-averaged PAEC(Rn) ranged from 1.0 to 59.0 mWL. The ratios of the indoor PAEC(Tn) to indoor PAEC(Rn) ranged from 0.09 to 0.58, with an overall average ratio of 0.32 and a standard deviation of 0.15. The 10 L min-1 flow rate through the filter was selected to approximate the air intake rate of a resting human; the time-averaged PAEC thus represents the progeny concentrations that would have been inhaled by a person breathing the same atmosphere.

43282 Evaluation of radon mitigation systems in 14 houses over a two-year period. Prill, R.J. (Lawrence Berkeley Laboratory, CA (USA)); Fisk, W.J.; Turk, B.H. *Journal of the Air and Waste Management Association (USA)*, 40(5): 740-748 (May 1990).

Fourteen single-family detached houses in Spokane, Washington, and Coeur D'Alene, Idaho, were monitored for two years after high concentrations of indoor radon had been mitigated. Each house was monitored quarterly using mailed alpha-track radon

detectors deployed in each zone of the structure. To assess performance of mitigation systems during the second heating season after mitigation, radon concentrations in seven houses were monitored continuously for several weeks, mitigation systems in all houses were inspected, and selected other measurements were taken. In addition, occupants were also interviewed regarding their maintenance, operation, and subjective evaluation of the radon mitigation systems. Quarterly alpha-track measurements showed that radon levels had increased in most of the homes during many follow-up measurement periods when compared with concentrations measured immediately after mitigation. Mitigation-system performance was adversely affected by (1) accumulated outdoor debris blocking the outlets of subsurface pressurization pipes; (2) fans being turned off (e.g., because of excessive noise or vibration); (3) air-to-air heat exchanger, basement pressurization, and subsurface ventilation fans being turned off and fan speeds reduced; and (4) crawl-space vents being closed or sealed.

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Refer also to citation(s) 42559, 42584, 43036, 43274

43283 (ANL/ESD/TM–9) **Site characterization and qualitative human risk assessment for the Walter Reed Army Institute of Research Building Site, Forest Glen, Maryland.** Harrison, W. (Argonne National Lab., IL (USA). Energy Systems Div.); Nashold, B.; Meshkov, N.K.; Tome, C.; Boparai, A.S.; Heinrich, R.R.; Graczyk, D.G.; Sandberg, S.A.; Foster, S.A.; Schweighauser, M.J.; Russell, J.J. Argonne National Lab., IL (USA). Energy Systems Div. Jul 1990. 601p. Sponsored by U.S. Department of Defense. DOE Contract W-31109-ENG-38. Order Number DE90014801. Source: NTIS, PC A99/MF A01 - OSTI; GPO Dep.

The proposed eight-acre building site for the Walter Reed Army Institute of Research (WRAIR) facility is a former uncontrolled landfill. As a prerequisite to foundation design and to formulation of an excavation plan, it was necessary to characterize the landfill materials and to conduct a qualitative human risk assessment. Chemical analysis of surface-water, groundwater, and landfill soils followed the analytical protocol promulgated under the US Environmental Protection Agency's (EPA's) Contract Laboratory Program for its Target Compound List of contaminants. This protocol was used to determine concentrations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) polychlorinated biphenyls (PCBs)/pesticides, inorganic compounds, radioactive materials, asbestos, and many of the metals analyzed. 49 refs., 19 figs., 24 tabs.

43284 (CDTN-DETM-PD–012/85) **Petrographic-mineralogical characterization with liberation grade, X ray and chemical diffractometry in ore samples of Itataia-CE mine.** Salas, H.T. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 24 Jul 1985. 66p. (In Portuguese). Order Number DE90635217. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

From samples collected by geologists in several points of G2 and G3 gallery of Itataia Uranium Phosphate mine, intended to get knowledge about several lithologic types of ores, mainly its alteration grades. Petrographic-mineralogical studies, liberation grade calculation of apatite, X-ray diffractometry analysis and dosage of oxydes by X-ray fluorencence are executed. (C.M.).

43285 (CEAC-R–1(90)) **Track-etch detection of radon in soils.** Cervantes Gonzales, P. (Centro de Estudios Aplicados al Desarrollo de la Energia Nuclear, La Habana (Cuba)); Gonzalez, D. Centro de Estudios Aplicados al Desarrollo Nuclear (CEADEN), La Habana (Cuba); Instituto Superior de Ciencia y Tecnologia Nuclear (ISCTN), La Habana (Cuba). 1990. 24p. (In Spanish). Order Number DE90635218. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In this work it is described the methodology to apply the track-etch technique, using detectors of nitrocellulose LR-115, for the detection of radon in soil. It is supported the use of the new detector carries and determined the parameters for revealing and counting of tracks in our conditions. It is shown in a preliminary way that this method gives better possibilities for analysis than another traditional technique to radon detection. The existence of radon was determined in the test zone. 15 refs.

43286 (CONF-8812141–1) **A percolation model of ecological flows.** Gardner, R.H.; Turner, M.G.; Dale, V.H.; O'Neill, R.V. Oak Ridge National Lab., TN (USA). [1988]. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Scope workshop, landscape boundaries: consequence for biotic diversity and ecological flows; Paris (France); 12-16 Dec 1988. Order Number DE90014211. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The boundary zone between adjacent communities has long been recognized as a functionally important component of ecosystems. The diversity and abundance of species, the flow and accumulation of material and energy, and the propagation of disturbances may all be affected by landscape boundaries. However, the spatial arrangement of different habitats and their boundaries has received little direct study. The difficulty in studying landscape boundaries has been due, in part, to the variety of responses of organisms to ecotones. Therefore, definitive tests of relationships between ecological processes and the pattern of landscape boundaries will be greatly assisted by developing a standard against which comparisons can be made. Neutral models can define this standard by producing the "expected" Poisson distribution have been well established, but a general approach for relating ecological processes and landscape patterns must still be defined. The purpose of this chapter is to illustrate how neutral models that are developed from percolation theory can be used to address the problem "How do ecological system boundaries influence biotic diversity and the flow of energy, information and materials?" 26 refs., 4 figs., 1 tab.

43287 (CONF-9007135–1) **Use of percolation theory and Latin hypercube sampling in field-scale solute transport investigations.** Luxmoore, R.J. (Oak Ridge National Lab., TN (USA)); Jardine, P.M.; Gardner, R.H.; Wilson, G.V. Oak Ridge National Lab., TN (USA). [1990]. 3p. Sponsored by Swiss Federal Institute of Technology. DOE Contract AC05-84OR21400. From 1. international symposium on forest soils; Harbin (China); 22-27 Jul 1990. Order Number DE90013433. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Investigations of rain-fed solute transport have been conducted at a forested hillslope site by using an in situ soil pedon and a subsurface hydrologic monitoring facility. Complementary solute transport studies on undisturbed soil columns taken from the field site have not provided data that can be directly applied to the field situation. Scaling up from columns to pedons and from pedons to hillslopes is being evaluated with percolation theory and Latin hypercube sampling methods. Percolation theory provides a means of identifying mobile zones and stagnant zones for given soil structural attributes which can be compared with column dye tracing results. The generation of frequency distributions of backwater and backbone porosities for a range of total soil porosities and pore arrangements may provide a stochastic representation of soil systems suitable for scaling up from the column scale to the pedon using the Latin hypercube sampling method. 9 refs.

43288 (INP–1379/AP) **Report to the International Atomic Energy Agency: Agency research contract no 4121/R1/RB.** Woznicka, U. Institute of Nuclear Physics, Cracow (Poland). 1987. 65p. Order Number DE90635221. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The results of research done under the International Atomic Energy Agency Contract No 4121/R1/RB: "Measurement of the thermal neutron macroscopic absorption cross-section on small rock samples" at the Institute of Nuclear Physics during the period from July 1, 1986 to June 30, 1987 are presented. The report contains the development of methodology of data treatment including condition of accumulation of the die-away curve, research on detection of systematic error in the measurement method and the description of the interpretation procedure of the experimental results. 17 refs., 17 figs., 7 tabs. (author).

43289 (KVL-JI-MEDD–62) **Separation of liquid manures with the aim of achieving a low nutrient content in the liquid**

fraction. Henriksen, K.; Berthelsen, L. Kongelige Veterinaer- og Landbohoejskole, Tastrup (Denmark). Jordbrugsteknisk Inst. Dec 1989. 106p. (In Danish). Order Number DE90512557. Source: NTIS (US Sales Only), PC A06/MF A01.

The project deals with a method to treat the thin fraction of mechanically separated liquid manure in such a way that a new thin fraction with low content of nutrients appears. This fraction can be irrigated without any restrictions on the farmland all the year round. Besides, a thicker fraction containing the major part of the nutrients appears. This part should be stored and treated as liquid manuare. In this project the liquid manure was treated in two stages. At first a flocculent was added and here we found that the clay Bentonite was the very best of the material investigated. During this process the faeces will clot around the clay particles and sink to the bottom. After 2 treatments with Bentonite it is possible to remove the residue of organic matter from the fluid. Now the ammonium production has stopped, but there will still remain ammonium and other inorganic alsts dissolved in the fluid. At the next stage the ammonium will be removed when an ion exchanger is added. For this purpose the minerals called Zeolites are suitable. They exchange some of their ions with the ammonium dissolved in the fluid. After that the ammonium ions are so firmly connected to the mineral molecules that only the plant roots and micro organisms will be able to remove them. The ions liberated by the ion exchanger are quite neutral and will not cause any pollution. The investigations in this report are made on liquid manure from pigs, as we concluded it was most important to start here. It was also interesting to see how different types of manure from pigs worked, but the mechanical separation caused a more uniform liquid manure. Among other things, the litter was separated away, and therefore the variation of the amount of litter had no indluence. (CLS) 26 refs.

43290 (LA–11733-M) **A manual for analysis of hemispherical canopy photography.** Rich, P.M. (Stanford Univ., CA (USA). Dept. of Biological Sciences). Los Alamos National Lab., NM (USA). Dec 1989. 80p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. Order Number DE90014718. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Hemispherical canopy photography involves taking photographs through a hemispherical (fisheye) lens pointed upward from beneath a plant canopy. The resulting photographs can be analyzed to determine the geometry of canopy openings and to calculate potential light penetration. This manual serves as a comprehensive guide to the program CANOPY©, a public domain microcomputer program for image analysis of hemispherical canopy photography. Included are discussions of theory, research applications, field methodology, hardware setup and operation, and software setup and operation. CANOPY enables video digitization of negatives, real-time display of positive images, interactive determination of a threshold to distinguish foliage from canopy openings, editing of photographs with poor exposure, rapid calculation of various measures of canopy geometry and indices of potential light penetration, and convenient output of results. A series of utility programs allow user specification of theoretical or empirical distributions of direct sunlight and diffuse skylight for a given site. 78 refs., 11 figs., 8 tabs.

43291 (LBL–28426) **Radioactive colloid advection in a sorbing porous medium: Analytical solution.** Light, W.B.; Lee, W.W.L.; Chambre, P.L.; Pigford, T.H. Lawrence Berkeley Lab., CA (USA). Jan 1990. 3p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (CONF-900608–50: American Nuclear Society annual meeting, Nashville, TN (USA), 10-14 Jun 1990). Order Number DE90015305. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Colloids are capable of increasing rates of hydrogeologic transport because they can move faster on average than solute due to hydrodynamic chromotography, they can be retarded less than solute by sorption onto rock, and they can increase the apparent liquid-phase radionuclide concentration. Colloid formation might occur as water carrying radionuclide solute leaves the immediate vicinity of the waste package and encounters changing geochemical conditions. Also, colloids of less soluble waste species might form as the waste matrix around them dissolves and migrates away. We restrict our analysis to "true colloids" that are a solid-phase of the radionuclide itself. To predict one-dimensional transport of colloids through a sorbing porous medium with coupling to the solute phase, we assume a concentration step function in time at the inlet boundary. We neglect dispersion and assume local sorption equilibrium with distinct retardation coefficients for the colloid and solute phases. We also assume local equilibrium between colloid and solute phase concentrations, resulting in solute concentration of the colloid solubility limit whenever the colloid phase is present. Colloid filtration is neglected. We expect the colloid front to travel faster than that of the solute as result of disparities in retardation. The solution involves mathematical difficulties. The analytical solution described in this paper provides unique insight to the fundamental behavior of a colloid system. 1 fig.

43292 (LUNBDS-NBBE–1033-1-18-1989) **Soil acidity and vegetation changes in South Swedish forests.** Falkengren-Grerup, U. Lund Univ. (Sweden). Dept. of Ecology. 15 Dec 1989. 18p. Order Number DE90512611. Source: NTIS (US Sales Only), PC A03/MF A01.

Changes in chemical soil properties and field layer species were studied by comparing investigations from 1979-88 with 1929-54 and 1949-70 and stemflow trasects around beech trees with regional beech stands. pH decreases, being 0.8 over 30-35 years and 0.2 over 15-20 years in the topsoil of deciduous forests, were found also at 100 cm depth. The exchangeable amounts of base cations (Na+K+Mg+Ca) had decreased to ca 50% of the original pool, while exchangeable Al had increased in all sites. It is concluded that atmospheric acidification is a major reason for the reported soil changes in southern Sweden. Stemflow transects act as small-scale experiments in soil acidification. pH, exchangeable Ca and Mg were lower close to the stem, especially in the least acid mull soils, gradually increasing 1.5 m outwards. The cover of individual species in the stemflow transects and the regional beech stands was closely related to soil pH. The similarity of the small and large scale approach showed the importance of the soil properties for the species reaction. The freguency curves (% presence) had however shifted towards lower pHs over 30-60 years, and repeated 15-35-year-old studies showed an increased cover of most species in spite of the soil acidification. A decrease in cover was only found at the lowest part of the species pH inverval. The increased nitrogen deposition is discussed as a plausible explaining factor for the increase in frequency and cover of a majority of the studied specis.

43293 (RIVM–728513012) **Selection of values for radionuclide-specific parameters, to be used in calculations of radionuclide transport in the biosphere and of radiation to man (PACOMA project): 3rd Technical report.** Lembrechts, J.F.; Koester, H.W. RIVM-Ministerie VROM-ECN Collaboration. Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Jul 1989. 31p. Order Number DE90635214. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Includes summary in Dutch.

Model calculations on radionuclide migration in the biosphere and on the resulting radiation doses to man have been made in order to evaluate various concepts on deep-lying radioactive waste repositories in salt formations. The different nuclide-specific parameters used in the model are discussed in this document. The data sources and the values selected for the model calculations are given. (author). 13 refs.; 4 figs.

43294 (RIVM–758904003) **Scopingreport radon.** Blaauboer, R.O.; Vaas, L.H.; Hesse, J.M.; Slooff, W. Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Sep 1989. 38p. (RIVM–758904). Order Number DE90635215. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Includes list of units and terms and list of abbreviations.

This report contains general information on radon concerning the existing standards, sources and emissions, the exposure levels and effect levels. It serves as a basis for the discussion during the exploratory meeting to be held in November/December 1989, aimed at determining the contents of the Integrated Criteria Document Radon. Attention is focussd on Rn-222 (radon) and Rn-220 (thoron), presently of public interest because of radon gas pollution in private homes. In the Netherlands air quality standards nor product standards for the exhalation rate of building materials have

been recommended. The major source of radon in the Netherlands is the soil gas (> 97%), minor sources are phosphate residues and building materials (> 2% in total). Hence, the major concern is the transfer through the inhalation of air, the lung being the most critical organ at risk to develop cancer. Compared to risks for humans, the risks of radon and its daughters for aquatic and terrestric organisms, as well as for agricultural crops and livestock, are assumed to be limited. In the Netherlands the average dose for man due to radon and thoron progeny is appr. 1.2 mSv per year, the estimated dose range being 0.1-3.5 mSv per year. This dose contributes about 50% to rhe total exposure due to all sources of ionizing radiation. Of this dose 80% is caused by radon and about 90% is received indoor. The estimated dose for the general population corresponds to a risk for inducing fatal cancers of about 15 x 10-6 per year, ranging from 1.2 x 10-6 to 44 x 10-6 which exceeds the risk limit of 1 x 10-6 per year as defined in the standardization policy in the Netherlands for a single source of ionizing radiation-with a factor 15 (1- 44). Reduction of exposure is only possible in the indoor environment. Several techniques have been described to reduce the indoor dose, resulting from exhalation of the soil and building materials.

43295 (SNV–3701) **Metal leaching from waste deposits.** Lindfors, L.G. (Swedish Environmental Research Inst., Stockholm (Sweden)). National Swedish Environmental Protection Board, Solna (Sweden). Dec 1989. 22p. (In Swedish). (RVF-PUBL–89-8). Order Number DE90512623. Source: NTIS (US Sales Only), PC A03/MF A01.

A literature survey of proved relationships between leach water composition, primarily as regards metals, and waste deposit processes has been made. The aim has been to make clear if proved relationships support the general assumption that leach water from deposits in well developed methane stage show low metal concentrations. All deposits that contain a marked amount of microbially decomposable organic matter in time puts through a number of phases, where the interior environment of the deposit changes. In chronological order the most important phases are: * Acid stage, when organic matter in the main is converted into organic fatty acids resulting in low pH and high contents of BOD, COD and metals in the leach water; * Methane stage, when organic matter is converted into methane and carbon dioxide under reductive conditions. During this phase the pH increases. In the main reduction of sulphate into sulphide is also secured. This leads to an increased solidification of metals by sorption and precipitation, and; * Maturing stage, when biological activity decreases. During this phase several processes may lead to an increase of the leach water metal contents. The time lapse of the respective phases may however vary consierably between different deposits. The acid phase and methane phase courses are considered well documented i.e. during a well developed methane phase in round municipal deposites the metal contents of the leach water are low to very low. The indiviual role of various metal solidification processes is however not known in detail. It is not possible to state whether there are possiblilities of co-depositing with other metal carrying wastes or not. The processes during the maturing phase are unknown. (3 figs., 4 tabs., 11 refs.).

43296 (SNV–3702) **Biological and chemical characterization of superficial leach waters.** Bjoerklund, I. National Swedish Environmental Protection Board, Solna (Sweden). Dec 1989. 167p. (In Swedish). (RVF-PUBL–89-9). Order Number DE90512622. Source: NTIS (US Sales Only), PC A08/MF A01.

The biological and chemical characterization aims to provide data for assessing the potential environmental hazard arising in the discharge of surface leachate from landfills. The investigation consists of a first study of temporary variations in composition and toxicity of leachate from two landfills within different climatic zones during one year. A more comprehensive study was then coducted which covered bilogical and chemical characterization of leachate from eight different landfills located in southern and central Sweden. The aim was to illustrate variations in toxicity and pollution flow and also test and adapt normal screening test methods for characterization of complex industrial waste water. (26 refs.).

43297 Contribution of deforestation to atmospheric CO_2 and reforestation as an option to control CO_2. Kinsman, J.D. (Edison Electric Inst., Washington, DC (USA)); Marland, G. pp. 49 of Proceedings of the Air and Waste Management Assoc. 82nd annual meeting and exhibition (Abstracts). Air and Waste Management Assoc., Pittsburgh, PA (USA) (1989). (CONF-890692–: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, CA (USA), 25-30 Jun 1989).

Technical Report 89-148.5.

Deforestation is occurring over broad areas of the tropics but at present there is great uncertainty regarding the rate. The net carbon flux from tropical forests is poorly known but could be as much as 30-50% of the emissions to the atmosphere from fossil fuel combustion. Four broad classes of forest management practice could play roles in controlling atmospheric CO_2: decreasing deforestation; increasing the productivity of existing forests; planting additional areas of forest; and using wood as a replacement for fossil fuels. Proposals, many of which have been described in this paper, have been forwarded in each of these areas and variations of each show potential as important tools for controlling atmospheric CO_2. Only one project is actually underway, to plant trees in Guatemala to offset CO_2 emissions from a power plant in the state of Connecticut. It appears that the developed nations can interact with the developing countries to reduce deforestation and promote reforestations. Public policy considerations and proposals, both foreign and domestic, are discussed.

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Refer also to citation(s) 42353, 42371, 42559, 42567, 42581, 42582, 42620, 42643, 42916, 43112, 43283, 43335

43298 (DTH-ISVA-PR–69, pp. 61-77) **Multicomponent solute transport with equilibrium chemistry: Tracking a dissolution front.** Engesgaard, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. 1989. In *Progress report no. 69.* Order Number DE90512540. Source: NTIS (US Sales Only), PC A05/MF A01.

A one-dimensional hydrogeochemical transport model is presented. The model is based on a sequential iteration approach (SIA) with total aqueous component concentrations as primary dependent variables (PDVs). This approach was chosen to fashion a coupling between a 1D finite-difference transport model and the PHREEQE equilibration code in order to track precipitation-dissolution fronts. A previously released model is used to verify the present model. Three test cases show that the chosen approach is a viable option for complex chemical system, and that the chosen PDVs can be used when solving for mineral distributions. (author) 21 refs.

43299 (ORNL–6613) **Gridmaker: A grid generator for two- and three-dimensional finite element subsurface flow models.** Tsay, T.K. (Syracuse Univ., NY (USA). Dept. of Civil Engineering); Yeh, G.T.; Wilson, G.V.; Toran, L.E. Oak Ridge National Lab., TN (USA). Jun 1990. 120p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014758. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3482.

This report documents the development and application of a grid generator, GRIDMAKER, for two- and/or three-dimensional domains. GRIDMAKER serves as a preprocessor for finite element models in solving two- and/or three-dimensional subsurface flow and pollutant transport problems. This grid generator is designed to generate three-point triangular or four-point quadrilateral elements for two-dimensional domains and eight-point hexahedron elements for three-dimensional domains. Based on the method of conformal mapping, the generation of interior nodal points within a two-dimensional domain of interest is performed numerically by the boundary integral element method (BIEM). For a three-dimensional domain, the BIEM techniques are applied in the projected horizontal plane, while the vertical coordinate is transformed by a normalized transformation using local layer thickness. Examples of grid generation for a two-dimensional domain and a three-dimensional three-layer domain are shown to demonstrate the capability of GRIDMAKER. A two-dimensional domain of an aquifer with a variable-depth layer is treated as a special case for depth-integrated two-dimensional, finite element subsurface flow models.

The program has also been designed to accommodate the need for aquifers with heterogeneous systems by identifying the type of material in each element. 5 refs., 17 figs., 1 tab.

43300 (ORNL/TM–11460) **Comparison of two freshwater turtle species as monitors of environmental contamination.** Meyers-Schoene, L. (IT Corp., Knoxville, TN (USA)); Walton, B.T. Oak Ridge National Lab., TN (USA). Apr 1990. 163p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014779. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Thesis submitted by L. Meyers-Schoene to Univ. of Tennessee, Knoxville.

Two species of turtles that occupy different ecological niches were compared for their usefulness as monitors of contamination in freshwater ecosystems. Trachemys scripta (Agassiz) and Chelydra serpentina (Linnaeus) were selected for comparison based on species abundance and differences in food habits and sediment contact. A review of the literature on contaminants in turtles and results of preliminary surveys conducted at the field sites, which are included in this study, were used to direct and focus this research project. White Oak Lake, a settling basin for low-level radioactive and nonradioactive contaminants, and Bearden Creek Embayment, an uncontaminated reference site upriver, were used as study sites in the investigation of turtles as indicators of chemical contamination. Turtles were analyzed for concentrations of strontium-90, cesium-137, cobalt 60, and mercury in specific target tissues, and for single-stranded DNA breaks, a non-specific indicator of possible exposure to genotoxic agents in the environment. 133 refs., 2 figs., 15 tabs.

43301 (PNL–7396) **Hanford Site ground-water surveillance for 1989.** Evans, J.C.; Bryce, R.W.; Bates, D.J.; Kemner, M.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 209p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE90015556. Source: NTIS, PC A10/MF A01; OSTI; INIS; GPO Dep.

This annual report of ground-water surveillance activities provides discussions and listings of results for ground-water monitoring at the Hanford Site during 1989. The Pacific Northwest Laboratory (PNL) assesses the impacts of Hanford operations on the environment for the US Department of Energy (DOE). The impact Hanford operations has on ground water is evaluated through the Hanford Site Ground-Water Surveillance program. Five hundred and sixty-seven wells were sampled during 1989 for Hanford ground-water monitoring activities. This report contains a listing of analytical results for calendar year (CY) 1989 for species of importance as potential contaminants. 30 refs., 29 figs,. 4 tabs.

43302 (SNV–3703) **Leach water influence on ground water at waste dumps: Main report.** Gustafsson, G. (VIAK AB, Goeteborg (SE)); Holm, T. National Swedish Environmental Protection Board, Solna (Sweden). Dec 1989. 72p. (In Swedish). (RVF-PUBL–89-11). Order Number DE90512621. Source: NTIS (US Sales Only), PC A04/MF A01.

The impact of leachate from sanitary landfills on groundwater is mostly unknown. In this study a methodology based on a conceptual geohydrological model of the landfill has been developed. The method has been applied to four different landfills in Sweden. At each landfill the potential risk of groundwater contamination has been evaluated by a geohydrological model followed by field investigations, including geophysical measurements and groundwater sampling. Results and conclusions are discussed. The study also includes a theoretical review of processes influencing groundwater contamination from leachate. (16 figs., 7 tabs., 23 refs.).

43303 (USGS/OFR–89-595) **Hydrologic, meteorological, and unsaturated-zone moisture-content data, Franklin Lake playa, Inyo County, California.** Czarnecki, J.B. Geological Survey, Denver, CO (USA). 1990. 38p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AI08-78ET44802. Order Number DE90015296. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Hydrologic and other data were collected at Franklin Lake playa, one of the principal discharge areas of the Furnace Creek Ranch-Alkali Flat ground-water flow system, located in southern Nevada and adjacent California. This data will be used to further characterize ground-water discharge that occurs at the playa largely as bare-soil evaporation. Data presented include: hydrographs of water levels in piezometers; vertical hydraulic gradients estimated from piezometer-nest data; meteorological data from weather stations in the vicinity of Franklin Lake playa; and estimates of moisture fluxes based on changes in soil-moisture content in the unsaturated zone. 10 refs., 8 figs., 9 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 43099, 43239

5502 Biochemistry

Refer also to citation(s) 43080, 43084, 43318, 43319, 43320, 43322, 43338

43304 (CONF-9004221–4) **Pattern recognition in DNA sequences: The intron-exon junction problem.** Mural, R.J. (Oak Ridge National Lab., TN (USA)); Uberbacher, E.C.; Mann, R.C. Oak Ridge National Lab., TN (USA). [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 1. international conference on electrophoresis, superconducting and the human genome; Tallahassee, FL (USA); 10-13 Apr 1990. Order Number DE90015182. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the fundamental problems facing the field of genomic sequence analysis is the difficulty in locating relatively small coding regions of DNA within the much larger non-coding regions. Neural networks, linguistic analysis and various types of expert systems have been used with various degrees of success to address this problem. We have developed several methods for recognizing the presence of splice junctions and coding DNA which are based on artificial intelligence, linguistic and statistical approaches. The triplet vocabulary in and around splice junctions has been analyzed for primates, and the occurrences of preferred triplets in potential junctions seems to be a very selective method for distinguishing true junctions from otherwise similar sequences. given a 50% mix of true and false junctions, this method scores 93%–95% correct. Several approaches have been used to identify exons. These include a frame bias matrix algorithm and an algorithm which estimates the fractal dimension of dinucleotide usage. Attempts are underway to combine the outputs of the various methods using a rule-based approach to improve the overall performance of these predictors. 13 refs., 4 figs.

43305 (DOE/ER/13575–4) **[Selected aspects of guard-cell biochemistry]: Progress report.** Outlaw, W.H. Jr. Florida State Univ., Tallahassee, FL (USA). 21 Jun 1990. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER13575. Order Number DE90015065. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Synopsis of progress on current grant. The studies were proposed for five years. The proposal was funded for three years, and I am pleased to report that the proposed experiments have been conducted, in essence, although some protocols were altered as the work unfolded. We found that Abscisic acid (ABA) accumulates in guard cells before it does in other leaf cells during stress imposition. This is an important result that eliminates a long-standing objection to unequivocal assignment of a role to ABA in stress-related decrease in stomatal conductance. We also followed the kinetics of ABA following relief of stress. In a published manuscript, we report values for protoplasts. The results did not permit a conclusion as to the cellular source of ABA. We did not detect physiological isoforms and therefore did not search for phosphorylation or aggregation states. We have been successful in measuring plant cytoplasmic malate concentration, though not in Crassula, which presented intractable technical difficulties. These results lead me to the heretical general conclusion that malate inhibition is not the major single factor that regulates phosphoenolpyruvate. 48 refs., 8 figs.

43306 (DOE/ER/13810–3) **The center for plant and microbial complex carbohydrates at The University of Georgia Complex Carbohydrate Research Center (CCRC): Annual progress report, September 15, 1989–September 14, 1990.** Albersheim, P.; Darvill, A. Georgia Univ., Athens, GA (USA). Research Foundation. Jun 1990. 107p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-87ER13810. Order Number DE90015388. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Complex Carbohydrate research Center (CCRC) has about 90 faculty, staff, postdoctoral research associates, and graduate students. The center grant funds are used to support training of graduate students, collaborative carbohydrate research projects with other institutions, service, and equipment maintenance. The subjects extend from oligosaccharides that protect plants against viruses to oligosaccharides that induce explants to flower, from receptors for oligosaccharides that elicit phytoalexins to oligosaccharides that regulate cation transport across plasma membranes, from the structures of pectic and hemicellulosic polysaccharides to the ability of pathogenesis-related enzymes to release phytoalexin elicitors from fungal cell walls, from the cloning of carbohydrate-degrading enzymes to the cloning of glycanase inhibitors, from the identification of oligosaccharides that kill plant cells to the cloning of receptors that perceive those oligosaccharides that inhibit root formation and stimulate flower formation, from characterization of bacterial polysaccharides that have useful physical characteristics to characterization of complex carbohydrates involved in Rhizobium symbioses, and from developing analytical methods to purify and characterize carbohydrates to the development of computer methods to reduce the need to structurally characterize carbohydrates. The CCRC's progress in collaborative research, training, and service is summarized in the appendices accompanying this report.

43307 (JINR-E–14-89-69) **Studies of a lipid membrane structure with the neutron diffractometer of JINR.** Gordelij, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics); Klose, G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1989. 5p. Order Number DE90635244. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

At the high flux pulsed reactor IBR-2 of JINR series of experiments with model and biological membranes have been done. These experiments have shown high efficiency in the field of membrane structure investigations with the DN-2 diffractometer and small angle neutron scattering installations. 10 refs.; 3 figs.

43308 (LA-UR–90-2456) **A Toda lattice model of DNA.** Christiansen, P.L. (Danmarks Tekniske Hoejskole, Lyngby (Denmark)); Scott, A.C.; Muto, V.; Lomdahl, P.S. Los Alamos National Lab., NM (USA). [1990]. 10p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9007136–1: 1990 summer workshop on nonlinear and chaotic phenomena in plasmas, solids, and fluids, Edmonton (Canada), 16-27 Jul 1990). Order Number DE90014901. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In recent years the possibility that anharmonic excitations could play a role in the dynamics of SNA has been considered by several authors. It has been suggested that solitons may be generated thermally at biological temperatures. The denaturation of the DNA double helix has been investigated by statistical mechanics methods and by dynamical simulations. Here the potential for the hydrogen bond in each base pair is approximated by a Morse potential. In the present paper we describe the Toda lattice model of DNA. Temperature enters via the initial conditions and through a perturbation of the dynamical equations. The model is refined by introduction of transversal motion of the Toda lattice and by transversal coupling of two lattices in the hydrogen bonds present in the base pairs. Using Lennard-Jones potentials to model these bonds we are able to obtain results concerning the open states of DNA at biological temperatures. 39 refs., 7 figs.

43309 (ORNL/FTR–3681) **[Thioredoxin and glutaredoxin systems]: Foreign trip report, June 30, 1990–July 7, 1990.** Hartman, F.C. Oak Ridge National Lab., TN (USA). 19 Jul 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90015138. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report describes the Jacques Monod Conference on "Intracellular Redox Control in Animals, Plants and Microrganisms by Thioredoxin and Glutaredoxin Systems," which was held in Roscoff, France, on July 1–7, 1990. I was given the opportunity to lecture on my group's work concerning chemical characterization of phosphoribulokinase and its regulation by thioredoxin. I was also asked to chair a half-day session on thioredoxin reductases, a family of regulatory proteins that are involved in processes as diverse as DNA replication in mammals and carbon fluxes through the Calvin cycle in plants. As a major theme of the conference was structure/function relationships of proteins, most topics were of direct relevance to many research endeavors in the Biology Division of ORNL.

43310 (RFP–4305) **Analysis of control samples using the beryllium antibody assay.** Clarke, S.M.; Segor, J.R. EG and G Rocky Flats, Inc., Golden, CO (USA). Rocky Flats Plant. 22 Jun 1990. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC34-90DP62349. Order Number DE90014813. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An immunological assay for detecting antibodies specific to beryllium has been developed at the Rocky Flats Plant. Before using the assay to screen Rocky Flats beryllium workers, it is necessary to study the response to individuals with no exposure to the metal. This paper describes the computerization of the laboratory instrument and the results of 24 control samples analyzed individually and as four-sample pools. 3 refs., 3 figs., 2 tabs.

43311 On the mechanism of sulfite activation of chloroplast thylakoid ATPase and the relation of ADP tightly bound at a catalytic site to the binding change mechanism. Du, Z. (Univ. of California, Los Angeles (USA)); Boyer, P.D. *Biochemistry (USA)*, 29(2): 402-407 (16 Jan 1990).

Washed chloroplast thylakoid membranes upon exposure to [^{3}H]ADP retain in tightly bound [^{3}H]ADP on a catalytic site of the ATP synthase. The presence of sufficient endogenous or added Mg^{2+} results in an enzyme with essentially no ATPase activity. Sulfite activates the ATPase, and many molecules of ATP per synthase can be hydrolyzed before most of the bound [^{3}H]ADP is released, a result interpreted as indicating that the ADP is not bound at a site participating in catalysis by the sulfite-activated enzyme. The authors present evidence that this is not the case. The Mg^{2+}- and ADP-inhibited enzyme when exposed to MgATP and 20-100 mM sulfite shows a lag of about 1 min at 22°C and of about 15 s at 37°C before reaching the same steady-state rate as attained with light-activated ATPase that has not been inhibited by Mg^{2+} and ADP. The lag is not eliminated if the enzyme is exposed to sulfite prior to MgATP addition, indicating that ATPase turnover is necessary for the activation. The release of most of the bound [^{3}H]ADP parallels the onset of ATPase activity, although some [^{3}H]ADP is not released even with prolonged catalytic turnover and may be on poorly active or inactive enzyme or at noncatalytic sites. The results are consistent with most of the tightly bound [^{3}H]ADP being at a catalytic site and being replaced as this Mg^{2+}- and ADP-inhibited site regains equivalent participation with other catalytic sites on the activated enzyme. The sulfite activation can be explained by sulfite combination at a P_i binding site of the enzyme-ADP-Mg^{2+} complex to give a form more readily activated by ATP binding at an alternative site.

43312 The S_3 state of photosystem II: Differences between the structure of the manganese complex in the S_2 and S_3 states determined by X-ray absorption spectroscopy. Guiles, R.D. (Lawrence Berkeley Laboratory, CA (USA)); Zimmermann, J.L.; McDermott, A.E.; Yachandra, V.K.; Cole, J.L.; Dexheimer, S.L.; Britt, R.D.; Sauer, K.; Klein, M.P.; Wieghardt, K.; Bossek, U. *Biochemistry (USA)*, 29(2): 471-485 (16 Jan 1990). DOE Contract AC03-76SF00098.

O_2-evolving photosystem II (PSII) membranes from spinach have been cryogenically stabilized in the S_3 state of the oxygen-evolving complex. The cryogenic trapping of the S_3 state was achieved using a double-turnover illumination of dark-adapted PSII preparations maintained at 240 K. A double turnover of PSII was accomplished using the high-potential acceptor, Q_{400}, which is the high-spin iron of the iron-quinone acceptor complex. EPR spectroscopy was the principal tool establishing the S-state composition

and defining the electron-transfer events associated with a double turnover of PSII. The inflection point energy of the Mn X-ray absorption K-edge of PSII preparations poised in the S_3 state is the same as for those poised in the S_2 state. This is surprising in light of the loss of the multiline EPR signal upon advancing to the S_3 state. This indicates that the oxidative equivalent stored within the oxygen-evolving complex (OEC) during this transition resides on another intermediate donor which must be very close to the manganese complex. An analysis of the Mn extended x-ray absorption fine structure (EXAFS) of PSII preparations poised in the S_2 and S_3 states indicates that a small structural rearrangement occurs during this photoinduced transition. A detailed comparison of the Mn EXAFS of these two S states with the EXAFS of four multinuclear μ-oxo-bridged manganese compounds indicates that the photosynthetic manganese site most probably consists of a pair of binuclear di-μ-oxo-bridged manganese structures.

43313 Isolation and structural characterization of a cDNA clone encoding the human DNA repair protein for O^6-alkylguanine. Tano, K. (Oak Ridge National Lab., TN (USA)); Shiota, S.; Collier, J.; Foote, R.S.; Mitra, S. *Proceedings of the National Academy of Sciences of the United States of America (USA)*, 87(2): 686-690 (Jan 1990). DOE Contract AC05-84OR21400.

O^6-Methylguanine-DNA methyltransferase a unique DNA repair protein present in most organisms, removes the carcinogenic and mutagenic adduct O^6-alkylguanine from DNA by stoichiometrically accepting the alkyl group on a cysteine residue in a suicide reaction. The mammalian protein is highly regulated in both somatic and germ-like cells. In addition, the toxicity of certain alkylating drugs in tumor and normal cells is inversely related to the levels of this protein. The cDNA of the human gene, henceforth named MGMT, has been cloned in an expression vector on the basis of its rescue of a methyltransferase-deficient (ada^-) Escherichia coli host. A 22-kDa active methyltransferase encoded entirely by the cDNA contains an amino acid sequence of 61 residues that bears 60-65% similarity with segments of E. coli methyltransferase which encompass the alkyl-acceptor residues. The human cDNA has no sequence similarity with the ada and ogt genes, due in part to differences in codon usage, and shows no detectable homology with E. coli genomic DNA. However, it hybridizes with distinct restriction fragments of human, mouse, and rat DNAs. The lack of methyltransferase observed in many human cell lines is due to the absence of the MGNT gene or to lack of synthesis and/or stability of its 0.95-kilobase poly(A)$^+$ RNA transcript.

43314 Stark effect in wild-type and heterodimer-containing reaction centers from Rhodobacter capsulatus. DiMagno, T.J. (Univ. of Chicago, IL (USA)); Norris, J.R.; Bylina, E.J.; Youvan, D.C.; Angerhofer, A. *Biochemistry (USA)*, 29(4): 899-907 (30 Jan 1990). DOE Contract W-31-109-ENG-38.

The effect of an external electric field on the optical absorption spectra of wild-type Rhodobacter capsulatus and two Rb. capsulatus reaction centers that have been genetically modified through site-directed mutagenesis was measured at 77 K. The two genetically modified reaction centers replace histidine M200, the axial ligand to the M-side bacteriochlorophyll of the special pair, with either leucine or phenylalanine. These substitutions results in the replacement of the M-side bacteriochlorophyll with bacteriopheophytin, forming a bacteriochlorophyll-bacteriopheophytin heterodimer. The magnitude of the change in dipole moment from the ground to excited state ($\Delta\mu_{app}$) and the angle δ between the Q_y transition moment and the direction of $\Delta\mu_{app}$ were measured for the special pair absorption band for all three reaction centers. The differences in the magnitude of $\Delta\mu_{app}$ and the angle δ between wild-type and heterodimer reaction centers are consistent with increased charge transfer in the heterodimer special pair. These results support calculations that place the special pair charge-transfer state higher in energy than the excited singlet state in wild-type Rb. capsulatus RCs.

43315 A-T and C-C$^+$ base pairs can form simultaneously in a novel multistranded DNA complex. Edwards, E.L. (Univ. of Texas, Dallas (USA)); Patrick, M.H.; Gray, D.M.; Fatliff, R.L. *Biochemistry (USA)*, 29(3): 828-836 (23 Jan 1990).

Previous experiments have established that in certain synthetic oligomeric DNA sequences, including mixtures of $d(AACC)_5$ with $d(CCTT)_5$, adenine-thymine (A·T) base pairs form to the exclusions of neighboring protonated cytosine-cytosine (C·C$^+$) base pairs. In the present work, circular dichroism and other measurements were used to study DNA oligomers that represented two additional classes with respect to the formation of A·T and/or C·C$^+$ base pairs. (1) One class included two sets of repeating pentameric DNA sequences, $d(CCAAT)_{3-6}$ and $d(AATCC)_{4,5}$. Spectral data showed that as few as 40% C·C$^+$ base pairs were stable in two sets of oligomers in which A·T base pairs did not form adjacent to, or in place of, C·C$^+$ base pairs. (2) Another class of oligomer was represented by $d(C_4A_4T_4C_4)$, which was studied by CD, HPLC, and centrifugation experiments. This sequence was able to form both types of base pairs as the pH and temperature were lowered. The authors suggest that those sequences that formed only A·T base pairs had an antiparallel-strand orientation while those that formed only C·$^+$ base pairs probably had a parallel-strand orientation. They propose that $d(C_4A_4T_4C_4)$ at low pH adopted a multistranded structure that contained both parallel-stranded C·C$^+$ base pairs and antiparallel-stranded A·T base pairs.

43316 Structural consequences of nickel versus macrocycle reductions in F430 models: EXAFS studies of a Ni(I) anion and Ni(II) π anion radicals. Furenlid, L.R. (Brookhaven National Lab., Upton, NY (USA)); Renner, M.W.; Fajer, J.; Smith, K.M. *Journal of the American Chemical Society (USA)*, 112(4): 1634-1635 (14 Feb 1990).

Factor 430 (F430) is a nickel tetrapyrrole (hydrocorphin) found in methyl coenzyme M reductase, the enzyme that catalyzes the final stages of the reduction of carbon dioxide to methane in methanogenic bacteria. Reduction of Ni(II) F430 and isobacteriochlorins unambiguously results in Ni(I) species whereas porphyrins, chlorins, and hexahydro- and octahydroporphyrins yield anions variously ascribed to Ni(I) or Ni(II) π radicals with some metal character. The authors present here EXAFS results for the Ni(II) radical anions of a chlorin and a porphycene and for the Ni(I) anion of an isobacteriochlorin (iBC) that clearly demonstrate the structural consequences of metal versus macrocycle reductions.

43317 Positron emitter labeled enzyme inhibitors. Fowler, J.S.; MacGregor, R.R.; Wolf, A.P.; Langstrom, B. To Dept. of Energy, Washington, DC. USA Patent 4913891/A/. 3 Apr 1990. Filed date 22 May 1987. USA Patent Application 7-052,921. Int. Cl. A61K 49/02. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This invention involves a new strategy for imagining and mapping enzyme activity in the living human and animal body using positron emitter-labeled suicide enzyme inactivators or inhibitors which become covalently bound to the enzyme as a result of enzymatic catalysis. Two such suicide inactivators for monoamine oxidase have been labeled with carbon-11 and used to map the enzyme subtypes in the living human and animal body using PET. By using positron emission tomography to image the distribution of radioactivity produced by the body penetrating radiation emitted by carbon-11, a map of functionally active monoamine oxidase activity is obtained. Clorgyline and L-deprenyl are suicide enzyme inhibitors and irreversibly inhibit monoamine oxidase. When these inhibitors are labeled with carbon-11 they provide selective probes for monoamine oxidase localization and reactivity in vivo using positron emission tomography.

5503 Cytology

Refer also to citation(s) 43305, 43307, 43318

5504 Genetics

43318 (CONF-8907145–2) **Molecular and clonal analysis of in vivo hprt [hypoxanthine-guanine phosphoribosyltransferase] mutations in human cells: Revision.** Albertini, R.J. (Vermont Univ., Burlington, VT (USA). Genetics Lab.); O'Neill, J.P.; Nicklas, J.A.; Allegretta, M.; Recio, L.; Skopek, T.R. Vermont Univ., Burlington, VT (USA). 8 Aug 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60502. From Biomonitoring and carcinogen risk assessment meeting; Cambridge (UK);

27-28 Jul 1989. Order Number DE90015561. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There is no longer doubt that gene mutations occur in vivo in human somatic cells, and that methods can be developed to detect, quantify and study them. Four assays are now available for such purpose; two detecting mutations that arise in bone marrow erythroid stem cells and two defining mutations that occur in T-lymphocytes. The red cell assays measure changes in mature red blood cells that involve either the blood group glycophorin-A locus or the hemoglobin loci; the lymphocyte assays score for genetic events at either the X-chromosomal hypoxanthine-guanine phosphoribosyl-transferase (hprt) locus. We describe here our attempts in studying in vivo gene mutations in human T-lymphocytes. 35 refs., 3 figs., 3 tabs.

43319 (LA-UR-90-2373) **Computational methods for physical mapping of chromosomes.** Torney, D.C. (Los Alamos National Lab., NM (USA)); Schenk, K.R.; Whittaker, C.C.; White, S.W. Los Alamos National Lab., NM (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9004221-2: 1. international conference on electrophoresis, superconducting and the human genome, Tallahassee, FL (USA), 10-13 Apr 1990). Order Number DE90014916. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A standard technique for mapping a chromosome is to randomly select pieces, to use restriction enzymes to cut these pieces into fragments, and then to use the fragments for estimating the probability of overlap of these pieces. Typically, the order of the fragments within a piece is not determined, and the observed fragment data from each pair of pieces must be permuted N1! x N2! ways to evaluate the probability of overlap, N1 and N2 being the observed number of fragments in the two selected pieces. We will describe computational approaches used to substantially reduce the computational complexity of the calculation of overlap probability from fragment data. Presently, about 10^{-4} CPU seconds on one processor of an IBM 3090 is required for calculation of overlap probability from the fragment data of two randomly selected pieces, with an average of ten fragments per piece. A parallel version has been written using IBM clustered FORTRAN. Parallel measurements for 1, 6, and 12 processors will be presented. This approach has proven promising in the mapping of chromosome 16 at Los Alamos National Laboratory. We will also describe other computational challenges presented by physical mapping. 4 refs., 4 figs., 1 tab.

43320 (UCRL-102867) **The interaction of high-resolution electrophoresis and computational analysis in genome mapping.** Carrano, A.V.; Branscomb, E.W.; de Jong, P.J.; Mohrenweiser, H.; Olsen, A.; Slezak, T. Lawrence Livermore National Lab., CA (USA). 26 Jul 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-9004221-3: 1. international conference on electrophoresis, superconducting and the human genome, Tallahassee, FL (USA), 10-13 Apr 1990). Order Number DE90015363. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The construction of physical maps and the determination of the DNA sequence of chromosome-size segments of the human genome is a complex, multidisciplinary undertaking. The approach we have taken to construct a physical map and sequence of human chromosome 19 typifies these interactions. We exploit the power of both acrylamide and agarose gel electrophoresis to provide a simple and versatile method for DNA fingerprinting and the creation of contigs or sets of overlapping genomic clones. Cosmid libraries are constructed from Yeast Artificial Chromosomes (YAC) clones or from flow-sorted chromosomes. Cosmid DNA isolated from the screened library array is cut with a combination of five restriction enzymes and the fragment ends labeled with one of four different fluorochromes. Our approach to contig construction uses a robotic system to label restriction fragments from cosmids with fluorochromes, use of an automated DNA sequencer to capture fragment mobility data in a high resolution multiplex mode processes the mobility data to determine fragment length and provide a statistical measure of overlap among cosmids; and display the contigs and underlying cosmids for operator interaction and access to a database. Data analyses and interactions are conducted over a network of SUN workstations using a set of software tools that we developed and coupled to a commercially available database. Applying these methods, we have analyzed 5154 cosmid clones and assembled 515 contigs for chromosome 19. Some of these contigs have been identified with known genes and many have been mapped to the chromosome by fluorescence in situ hybridization. Existing contigs are being extended by a combination of walking and fingerprinting. 21 refs., 2 figs.

43321 A strategy for fine-structure functional analysis of a 6- to 11-centimorgan region of mouse chromosome 7 by high-efficiency mutagenesis. Rinchik, E.M. (Oak Ridge National Laboratory, TN (USA)); Carpenter, D.A.; Selby, P.B. *Proceedings of the National Academy of Sciences of the United States of America (USA)*, 87(3): 896-900 (Feb 1990). DOE Contract AC05-84OR21400.

A refined functional map of a 6- to 11-centimorgan region surrounding the albino (c) locus in mouse chromosome 7 is being generated by N-ethyl-N-nitrosourea (EtNU) saturation mutagenesis of stem-cell spermatogonia. In the first phase of an experiment that will eventually test at least 3,000 gametes, the authors screened 972 mutagenized gametes for the induction of both lethal and visible mutations with a two-cross breeding protocol. Thirteen mutations mapping within the limits of a segment corresponding to the cytologically visible $Df(c\ Mod\text{-}2\ sh\text{-}1)^{26D9T}$ deletion were recovered. They represented three phenotypic groups: prenatal lethality (six mutations); a fitness/runting syndrome (three mutations, provisionally designated as fit variants); and a neurological/balance-defect abnormality (four mutations). Complementation analysis provided evidence for a true repeat mutation at the sh-1 (shaker-1) locus (for the neurological mutations) and another at the here defined fit-1 (fitness-1) locus. The recovery of the repeat mutations suggests that the EtNU-induced mutation rate, estimated from specific-locus tests, should make it possible to achieve saturation mutagenesis of a chromosomal region. This experiment is providing basic logistical and statistical information on which to base strategies for expanding the functional map of larger segments of the mouse genome by experimental mutagenesis.

43322 Nucleic acid isolation process. Longmire, J.L.; Lewis, A.K.; Hildebrand, C.E. To Dept. of Energy, Washington, DC (USA). USA Patent 4921952/A/. 1 May 1990. Filed date 20 Apr 1989. USA Patent Application 7-341,281. Int. Cl. C07H 21/00. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a process for preparing DNA from cellular materials for use in genetic studies of eukaryotic systems, a process for isolating DNA fragments from proteolytic digestion products and detergent products in a solution with the DNA fragments produced in stripping undesired cellular constituents from the DNA. It comprises the step of dialyzing a solution containing the DNA fragments, detergent products, and proteolytic digestion products against a solution containing PEG for a time effective to yield DNA sufficiently pure of the genetic studies.

5505 Metabolism

Refer also to citation(s) 43268, 43339

5506 Medicine

Refer also to citation(s) 42967, 43101, 43204, 43317

43323 (BNL-44604) **Recent developments in monoclonal antibody radiolabeling techniques.** Srivastava, S.C.; Mease, R.C. Brookhaven National Lab., Upton, NY (USA). [1989]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8911189-1: International symposium on immunoscintigraphy facts and fictions, Gottingen (Germany, F.R.), 2-4 Nov 1989). Order Number DE90011201. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Monoclonal antibodies (MAbs) have shown the potential to serve as selective carriers of radionuclides to specific in vivo antigens. Accordingly, there has been an intense surge of research activity in an effort to develop and evaluate MAb-based radiopharmaceuticals

for tumor imaging (radioimmunoscintigraphy) and therapy (radioimmunotherapy), as well as for diagnosing nonmalignant diseases. A number of problems have recently been identified, related to the MAbs themselves and to radiolabeling techniques, that comprise both the selectivity and the specificity of the in vivo distribution of radiolabeled MAbs. This paper will address some of these issues and primarily discuss recent developments in the techniques for radiolabeling monoclonal antibodies that may help resolve problems related to the poor in vivo stability of the radiolabel and may thus produce improved biodistribution. Even though many issues are identical with therapeutic radionuclides, the discussion will focus mainly on radioimmunoscintigraphic labels. 78 refs., 6 tabs.

43324 (DOE/ER/60634–T2) **Theory of RBE [relative biological effectiveness]: Annual technical progress report, 1 January 1990–31 December 1990.** Katz, R. Nebraska Univ., Lincoln, NE (USA). Dept. of Physics. 15 Jul 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER60634. Order Number DE90014996. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Attention this period has focused on the following: improvement in knowledge of the radial distribution of dose about the path of an energetic heavy ion in different media; influence of radiation quality on the formation of DNA breaks in viruses; computation of response of glycylglycine from x-ray and heavy ion irradiations, investigations of track theory; uses and misuses of cross sections in radiobiology; response of E. Coli mutants to ionizing radiations: LET radiobiology; and radiation effects in different substances. (KJD)

43325 (WHC-SA–0744) **A revised model of the kidney for medical internal radiation dose calculations.** Patel, J.S. Westinghouse Hanford Co., Richland, WA (USA). Dec 1988. 60p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-900246–6: 23. Health Physics Society midyear topical symposium on risk analysis, Atlantic City, NJ (USA), 4-9 Feb 1990). Order Number DE90014396. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Presently, there is a need for a revised model for the kidneys which clearly distinguishes major regions and structures in the kidneys. This model is needed since radionuclides used currently in nuclear medicine have marked preferences for various regions of the kidneys, and the radiation dose to one or more of these regions is of primary importance. At this time the kidneys are modeled as solid organs of uniform density by the ALGAM computer code, which uses Monte Carlo techniques to calculate absorbed fractions. This presentation will introduce a model in which the source regions will be the cortex, medulla and the papillae, while the target regions will be these regions as well as the other organs of the body. This research presents for the first time estimates of the specific absorbed fractions in various organs of the body from a source in the specific region of the kidneys. 17 refs., 8 figs., 10 tabs.

43326 **Research involving hot atoms of nucleogenic origin and its practical application.** Ferrieri, R.A. (Brookhaven National Lab., Upton, NY (USA)); Wolf, A.P. pp. 2, Paper NUCL 1 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Over the years, a large body of information has amassed which has helped to clarify the authors understanding of the complex chemistry occurring within chemical systems immediately following a nuclear reaction. With the increased knowledge of how reactive nuclides generated by such processes react chemically, it became increasingly apparent that the translational or recoil energy imparted to such species was not always the driving force behind some of the unusual chemistry seen in these systems. In many instances, the state of electronic excitation was found to strongly affect their chemistry. In others, the concomitant radiation chemistry often altered initial chemical states. Even so, with just a general understanding of how these effects work in unison, it has been possible in many instances to predict radiolabel distributions and yields in molecules. This ability has had an enormous impact in other fields utilizing radiotracers in research. This presentation will highlight specific examples in basic hot atom research which have focused on these problems, and describe general applications to other disciplines using radiotracers.

43327 **Recent results from the chemistry of recoiling carbon and silicon atoms: The interplay between hot atom chemistry and gas kinetics.** Gaspar, P.P. (Washington Univ., St. Louis, MO (USA)); Garmestani, K.; Ferrieri, R.A.; Wolf, A.P. pp. 6, Paper NUCL 14 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Recent results from the chemistry of recoiling carbon and silicon atoms illustrate the power of an experimental approach to the solution of complex mechanistic problems that combines the study of the reactions of recoiling atoms with conventional gas kinetic techniques. Included will be the reactions of ^{11}C atoms with anisole, addressing the question whether an aromatic pi-electron system can compete as a reactive site with carbon-hydrogen bonds.

43328 **High specific activity carbon-11 and fluorine-18-labeled radiotracers: Three decades of progress.** Fowler, J.S. (Brookhaven National Lab., Upton, NY (USA)); Wolf, A.P. pp. 6, Paper NUCL 15 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Over the past two decades, radiotracer research and development has grown exponentially, stimulated by the growing use of ^{11}C and ^{18}F labeled compounds for tracing biochemical transformations occurring in living systems using positron emission tomography. The short half lives of these two nuclides and the synthesis of labeled compounds of sufficiently high specific activity to allow the principles of tracer kinetics to be applied in vivo has dominated their development as radiotracers. This has necessitated examination of target chemistry and the development new methods for rapidly incorporating a limited number of small labeled precursors such as carbon dioxide, hydrogen cyanide and fluoride ion into complex organic molecules. This presentation will trace the significant milestones in carbon-11 and fluorine-18 chemistry leading to the state of the field as we see it today as well as some of the remaining challenges in developing this unique class of tracers.

43329 **From Iodine-131 to short-lived positron emitters inn nuclear medicine: Changing perspectives in radionuclide use.** Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). pp. 14, Paper NUCL 43 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The key to the practice of Nuclear Medicine is the radiopharmaceutical, whether in its elemental form or incorporated in a compound. Post 1945, the availability of a wide variety of radionuclides in large quantity became feasible from nuclear reactors. Initial impetus to the field was given by the availability of fluorine-18 and iodine-131. The major step forward came with the introduction of technetium-99m. This element still accounts for the major fraction of nuclear medicine procedures in use today. However, a renaissance in the use of charged particle reaction occurring in concert with new types of imaging instrumentation and sophistication in radiochemical synthesis combined to make the use of the positron emitters carbon-11, nitrogen-13, oxygen-15 and fluorine-18 practical. In addition elements such as gallium-67, iodine-123, thallium-201 and others became readily available. A historical perspective will be presented but with an emphasis on the present and future.

43330 **The S_0 state of photosystem II induced by hydroxylamine: Differences between the structure of the manganese complex in the S_0 and S_1 states determined by X-ray absorption spectroscopy.** Guiles, R.D. (Lawrence Berkeley Lab., CA (USA)); Yachandra, V.K.; McDermott, A.E.; Cole, J.L.; Dexheimer, S.L.; Britt, R.D.; Sauer, K.; Klein, M.P. *Biochemistry (USA)*, 29(2): 486-496 (16 Jan 1990). DOE Contract AC03-76SF00098.

Hydroxylamine at low concentrations causes a two-flash delay in the first delay in the first maximum flash yield oxygen evolved from spinach photosystem II (PSII) subchloroplast membranes that have been excited by a series of saturating flashes of light. Untreated PSII membrane preparations exhibit a multiline EPR signal assigned to a manganese cluster and associated with the S_2 state

when illuminated at 195 K, or at 273 K in the presence of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU). The authors used the extent of suppression of the multiline EPR signal observed in samples illuminated at 195 K to determine the fraction of PSII reaction centers set back to a hydroxylamine-induced S_0-like state, which they designate S_0. The manganese K-edge X-ray absorption edges for dark-adapted PSII preparations with or without hydroxylamine are virtually identical. This indicates that, despite its high binding affinity to the oxygen-evolving complex (OEC) in the dark, hydroxylamine does not reduce chemically the manganese cluster within the OEC in the dark. After a single turnover of PSII a shift to lower energy is observed in the inflection of the Mn K-edge of the manganese cluster. They conclude that, in the presence of hydroxylamine, illumination causes a reduction of the OEC, resulting in a state resembling S_0. This lower Mn K-edge energy of S_0, relative to the edge of S_1, implies that storage and stabilization of an oxidative equivalent within the manganese cluster during the $S_0 \rightarrow S_1$ state transition. An analysis of the extended X-ray absorption fine structure (EXAFS) of the S_0 state indicates that a significant structural rearrangement occurs between the S_0 and S_1 states.

43331 Polarization transfer NMR imaging. Sillerud, L.O.; van Hulsteyn, D.B. To Dept. of Energy, Washington, DC (USA). USA Patent 4922203/A/. 1 May 1990. Filed date 31 Jan 1989. USA Patent Application 7-305,211. Int. Cl. G01R 33/20. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method for generating NMR images containing chemical information. It comprises: selecting a chemical compound with a functional element related to the chemical information and a transfer element for generating an NMR imaging signal, with nuclei of the functional element and the transfer element spin-coupled and covalently bound to define two NMR response peaks separated by a coupling constant under NMR excitation at a first frequency related to the transfer element in the compound; exciting a volume containing the compound with first pulses at the first frequency; applying electromagnetic gradients to the volume effective to spatially separate a response of the compound to the first frequency.

43332 Aminopropyl thiophene compounds. Goodman, M.M.; Knapp, F.F. To Dept. of Energy, Washington, DC. USA Patent 4914215/A/. 3 Apr 1990. Filed date 25 Aug 1989. USA Patent Application 7-398,574. Int. Cl. C07D 327/00. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes radiopharmaceuticals useful in brain imaging comprising radiohalogenated thienylethylamine derivatives. The compounds are 5-halo-thiophene-2-isopropyl amines able to cross the blood-brain barrier and be retained for a sufficient length of time to allow the evaluation of regional blood flow by radioimaging of the brain.

5507 Microbiology

43333 (DOE/ER/60478–2) **Microscopical and cultural examination of subsurface microorganisms: Final progress report, July 20, 1986–October 31, 1989.** Balkwill, D.L. Florida State Univ., Tallahassee, FL (USA). Dept. of Biological Science. 20 Feb 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER60478. Order Number DE90014624. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This document contains a detailed summary of technical accomplishments for the entire funding period (7/20/86–10/31/89) of DOE Grant No. FG05-86ER60478 to Florida State University. The more detailed scientific results of our efforts are described in four peer-reviewed publications, as well as in manuscripts (to be submitted for publication) that are still in preparation. Topics include analysis of samples from Savannah River Site (SRS), analysis of microbial cultures isolated from SRS samples, data handling, and cooperative investigations.

5509 Pathology

Refer also to citation(s) 43306

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

Refer also to citation(s) 43239

5601 Radiation Effects

Refer also to citation(s) 42582, 43294, 43300, 43324

43334 (ISH–137) **Dosimetry of internal emitters: At what level?.** Reddy, A.R. (Isotope Lab. DLJ, Jodhpur (India)); Roedler, H.D.; Kaul, A. Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Aug 1989. 100p. Source: Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The present review will focus attention at 4 different levels of dosimetry. Level one is where the dosimetry is done using the formulae 1.1 and 1.2 more stressing the importance of the proper biokinetics of radionuclide. At level 2 the key words are the microdistribution of acitivity in the biological system and energy deposition in a target of interest in the system (local dose estimates). Statistical fluctuations in energy deposited and the mean values to represent the distributions of specific energy imparted to a defined target and the lineal energy of the deposited energy is the subject matter at level 3 (microdosimetry). A brief mention of the spatial as well as temporal characterisation of the energy deposited and the species generated in the radiation interaction (track structure calculations) will be made as level 4 dosimetry at the end. As a prelude, however, status on various considerations with regard to target, radioactivity, its chemical form and the radiation interaction with the target that are pertinent for the levels of dosimetry mentioned above will be discussed first. (orig./MG).

43335 (PNL–7411-HEDR) **Phase 1 of the Hanford Environmental Dose Reconstruction Project: Draft Columbia River pathway report.** Pacific Northwest Lab., Richland, WA (USA). 20 Jul 1990. 85p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90014618. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report summarizes the water pathway portion of the first phase of the Hanford Environmental Dose Reconstruction (HEDR) Project, conducted by Battelle staff at the Pacific Northwest Laboratory under the direction of an independent Technical Steering Panel. The HEDR Project is estimating radiation doses that could have been received by the public from the Department of Energy's Hanford Site, in southeastern Washington State. Phase 1 of the water-pathway dose reconstruction sought to determine whether dose estimates could be calculated for populations in the area from above the Hanford Site at Priest Rapids Dam to below the site at McNary Dam from January 1964 to December 1966. Of the potential sources of radionuclides from the river, fish consumption was the most important. Later phases of the HEDR Project will address dose estimates for periods other than 1964–1966 and for populations downstream of McNary Dam. 17 refs., 20 figs., 1 tab.

43336 Regulation of protein kinase C by ionizing radiation. Woloschak, G.E. (Argonne National Laboratory, IL (USA)); Chang-Liu, C.M.; Shearin-Jones, P. *Cancer Research (USA)*, 50(13): 3963-3967 (1 Jul 1990).

Members of the protein kinase C (PKC) gene family have been shown to play an important role in tumor promotion and regulation of cell growth. Experiments were designed to examine the effects of different qualities of ionizing radiation administered at a variety of doses and dose rates on the expression of PKC-specific mRNA in confluent Syrian hamster embryo cells. The results of these experiments showed that low-linear energy of transfer (LET) radiations (such as X-rays and gamma-rays) can induce increased expression of PKC mRNA within 1 h after radiation exposure. Levels of expression of PKC mRNA were increased 4- to 6-fold over unirradiated controls. Dose effects were evident, with increased accumulation of PKC mRNA at higher doses (ranging from 6 to 200 cGy). Induction of PKC mRNA occurred at a time when total cellular transcription was reduced following irradiation. Similar exposure of the cells to fission spectrum JANUS neutrons, however, had little effect on PKC mRNA expression. Modest induction (2-fold

compared to untreated cells) occurred when irradiations were at very low dose rates (0.5 cGy/min). These results suggest that induction of PKC mRNA may be a step in the transformation process caused by ionizing radiation. In addition, they demonstrate that different qualities of radiation may regulate PKC differently.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 42371, 43242, 43268, 43310

43337 (BNL–44773) **Health and safety issues related to the production, use and disposal of cadmium-based photovoltaic modules.** Moskowitz, P.D. (Brookhaven National Lab., Upton, NY (USA)); Fthenakis, V.M.; Zweibel, K. Brookhaven National Lab., Upton, NY (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900542–15: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90015092. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discusses environmental, health and safety issues associated with the use of cadmium in thin-film cadmium telluride photovoltaic modules. Cadmium-related environmental, public health and occupational health hazards may arise during the manufacturing, use, and disposal of spent devices. In this context, photovoltaic processing technology, statutory/regulatory limits, toxicology, and health hazards associated with two processing alternatives (electrodeposition and spray pyrolysis) nearing commercialization are reviewed. To ensure the continued viability of this material alternative, control options to permit the safe use of cadmium are discussed. 11 refs.

43338 (BNL–44839) **DNA damage and repair in human skin: Pathways and questions.** Sutherland, B.M. (Brookhaven National Lab., Upton, NY (USA)); Hacham, H.; Sutherland, J.C.; Gange, R.W.; Maytum, D. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8910354–2: DNA damage and repair in human tissues conference, Upton, NY (USA), 1-4 Oct 1989; BIO–4595). Order Number DE90015126. Source: NTIS, PC A03/MF A01 - OSTI.

Skin is assaulted daily with physical and chemical carcinogens, promoters, and modifiers of biological responses to such agents. DNA is the principal target for most carcinogens, and DNA in skin is particularly at risk. It is subject to damage not only from ingested compounds and their metabolic products, but also from externally applied or encountered chemicals, as well as from physical carcinogens such as sunlight and cosmetic or medical source of ultraviolet radiation. Three major factors determine the balance between damage to DNA of skin and the biological consequences of that damage: the frequencies and types of lesions, the ability of the individual to repair a lesion, and the strategy that skin employs to deal with the different spectra of lesions inflicted under varying environmental conditions. Thus, cellular responses to DNA damage, including repair of DNA lesions, are critical factors in determining the final level of damage and its consequences. This paper discusses DNA damage and repair in human skin. 35 refs.

43339 (PB–90-217571/XAB) **Dose-related differences in DNA adduct levels in rodent tissues following skin application of complex mixtures from air pollution sources.** Gallagher, J.E.; Jackson, M.A.; George, M.H.; Lewtas, J. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1990. 8p. (EPA–600/J-90/037). Source: NTIS, PC A02/MF A01.

Pub. in Carcinogenesis, Vol. 11, No. 1, 63-68(Jan 1990).

Dose-related differences in the binding of DNA reactive intermediates for three environmentally important complex particulate extracts and a well studied carcinogen benzo(a)pyrene (B(a)P) were examined in female C-57 mice following multiple topical treatments ranging from (1-120) mg per mouse. Particulate extracts from coke oven, coal soot and diesel exhaust were selected as model complex mixtures based on short term mutagenicity assays, animal bioassays for carcinogenicity or epidemiological studies where increased incidences of lung cancer in exposed populations were detected. Positive and negative control animals were treated with either 1.2 mg Benzo(a)Pyrene or acetone alone. DNA was isolated from skin, lung and liver DNA 24 hours following the last application and analyzed for DNA adducts using the nuclease P1 version of the 32p-postlabeling assay. Each of the particulate extracts produced distinct patterns of DNA adducts. A broad diagonal radioactive zone (DRZ) presumably representing multiple DNA adducts, was observed for coke oven, coal soot and diesel modified DNA samples. One adduct, common to all three complex mixture modified DNA samples, comigrated with the major B(a)P adduct observed following treatment with B(a)P alone. These data have important implications for low dose risk assessment of these complex mixtures.

43340 (PB–90-591330/XAB) **Integrated Risk Information System (IRIS) (for IBM PC/AT microcomputers). Data file.** Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment. Apr 1990. vp. Source: NTISStanding Order.

Supersedes PB–88-215884. The data file is contained on 5 1/4-inch diskettes, high density (1.2M), compatible with the IBM PC/AT microcomputer. The diskettes are in the ASCII format. Available on Standing Order, Deposit Account required. North American Continent price based on number of updates; individual issue $130.00; all others write for quote. Issued quarterly.

The Integrated Risk Information System (IRIS), an on-line database of chemical-specific risk information, provides information on how chemicals affect human health and is a primary source of EPA risk assessment information on chemicals of environmental concern. It is intended to serve as a guide for the hazard identification and dose-response assessment steps of EPA risk assessments. IRIS makes chemical-specific risk information readily available to those who must perform risk assessments and also increases consistency in risk management decisions. The principal section of IRIS is the chemical files. The chemical files contain: oral and inhalation reference doses for noncarcinogens; oral and inhalation carcinogen assessments; summarized Drinking Water Health Advisories; summaries of selected EPA regulations; and supplementary data (for example, acute toxicity information and physical-chemical properties). The two primary types of health assessment information in IRIS are reference doses and carcinogen assessments.

43341 (PB–90-591340/XAB) **Integrated Risk Information System (IRIS) (for IBM PC microcomputers). Data file.** Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment. Apr 1990. vp. Source: NTISStanding Order.

Supersedes PB–88-215892. The data file is contained on 5 1/4-inch diskettes, double density (360K), compatible with the IBM PC microcomputer. The diskettes are in the ASCII format. Available on Standing Order, Deposit Account required. North American Continent price based on number of updates; individual issue $230.00; all others write for quote.

The Integrated Risk Information System (IRIS), an on-line database of chemical-specific risk information, provides information on how chemicals affect human health and is a primary source of EPA risk assessment information on chemicals of environmental concern. It is intended to serve as a guide for the hazard identification and dose-response assessment steps of EPA risk assessments. IRIS makes chemical-specific risk information readily available to those who must perform risk assessments and also increases consistency in risk management decisions. The principal section of IRIS is the chemical files. The chemical files contain: oral and inhalation reference doses for noncarcinogens; oral and inhalation carcinogen assessments; summarized Drinking Water Health Advisories; summaries of selected EPA regulations; and supplementary data (for example, acute toxicity information and physical-chemical properties). The two primary types of health assessment information in IRIS are reference doses and carcinogen assessments.

43342 (PB–90-591630/XAB) **Registry of Toxic Effects of Chemical Substances (RTECS), 1990 computer tape. Data file.** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 1990. mag ta Source: NTISSubscription.

Supersedes PB–89-900300. Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape

only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB–90-131582. Available on subscription, North American Continent price $2000.00/year; all others write for quote. Issued quarterly.

The tapes contain the data and bibliographic CODEN files of the 1990 Registry of Toxic Effects of Chemical Substances (RTECS). Formerly known as the Toxic Substances List, the Registry is an annual compendium of the toxicity data abstracted from the scientific literature by NIOSH in compliance with the Occupational Safety and Health Act of 1970. The 1990 RTECS file contains 364,248 entries; 104,317 are names of unique chemicals with their associated toxicity data and 259,931 entries are synonymous names. For each compound, the following data are provided: prime name and synonyms, CAS number, molecular weights and formulas, date when substance was last updated, Wiswesser Line Notations, irritation, mutation, reproductive effects, tumorigenic, and toxic dose data with references; toxicology reviews; carcinogenic assessments; government standards and regulations; ACGIH-Threshold Limit Values; NIOSH Recommended Exposure Limits, Surveillance Data, Current Intelligence Bulletins and Analytical Methods; NTP bioassay results; and EPA status.

43343 (PB–90-780438/XAB) **NLM microcomputer-based tutorials (for microcomputers). Software.** Perkins, M. National Library of Medicine, Washington, DC (USA). Apr 1990. vp. Source: NTISCP D01.

The data file is contained on 5 1/4 and 3 1/2-inch diskettes, double density (360K) and (720K), compatible with the IBM PC, XT, AT, PS2 microcomputer. The diskettes are in the ASCII format.

The package consists of TOXLEARN–a microcomputer-based training package for TOXLINE (Toxicology Information Online), CHEMLEARN-a microcomputer-based training package for CHEMLINE (Chemical Information Online), MEDTUTOR–a microcomputer-based training package for MEDLINE (Medical Information Online), and ELHILL LEARN–a microcomputer-based training package for the ELHILL search and retrieval software that supports the above-mentioned databases...Software Description: The programs were developed under PILOTplus using the NLM LEARN Programmer. They run on IBM-PC, XT, AT, PS/2, and fully compatible computers. The programs require 512K RAM memory, one disk drive, and DOS 2.0 or higher. The software supports most monochrome, color graphics, enhanced color graphics, or visual graphics displays.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 42826

43344 (PNL-SA–17199) **Effect of chronic 60-Hz electric field exposure on mammary tumorigenesis in the rat.** Anderson, L.E.; Leung, F.C.; Rommereim, D.N.; Buschbom, R.L.; Wilson, B.W.; Stevens, R.G. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. Order Number DE90015285. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Female rats were administered a single dosage of 7 or 10 mg of DMBA intragastrically between 50 and 55 days of age and palpated weekly for mammary tumors in two experiments. Rats were either exposed to a 40 kV/m 60-Hz electric field or sham-exposed in utero through 18 or 23 weeks of age. There was no difference between electric field exposed and sham-exposed in incidence of first tumor. When the results of the two experiments were combined, the electric field exposed groups had significantly more tumors per tumor-bearing animal than the sham-groups. These results may have implications for the role of electric power use in the etiology and promotion of breast cancer. 21 refs., 1 fig., 1 tab.

57 HEALTH AND SAFETY

Refer also to citation(s) 43618, 43620

43345 (RFP–4272) **Quality assurance as applied to an occupational medical surveillance program.** Furman, F.J. EG and G Rocky Flats, Inc., Golden, CO (USA). Rocky Flats Plant. 12 Jun 1990. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC34-90DP62349. Order Number DE90014812. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Surveillance of workers for effects of workplace hazards involves hazard identification and monitoring, worker identification, selection of appropriate medical protocol, onsite medical examination, as well as scheduling, evaluation, and recording of data. A computer-assisted quality assurance program was implemented to ensure that all steps in the process are accomplished in a complete and timely manner. 3 refs., 2 figs., 2 tabs.

43346 (RFP–4345) **Medical Department annual report, CY1988.** Furman, F.J.; Carden, P.L.; Bistline, R.W.; Clarke, S.M.; Baker, P.S.; Torres, W. EG and G Rocky Flats, Inc., Golden, CO (USA). Rocky Flats Plant. 12 Jun 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC34-90DP62349. Order Number DE90014811. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Medical Department at the Rocky Flats Plant offers comprehensive occupational health services to the employees and management. Twenty full-time and seven part-time and contract employees provide services to approximately 5000 Rockwell International and contractor workers at the Rocky Flats site. Services include standard occupational health programs: evaluation and treatment of minor illnesses and injuries, placement examinations, preventive programs, and employee assistance programs. Other services are provided because of the unique nature of the work performed at Rocky Flats. They include emergency management with emphasis on radiation accidents, health surveillance, and epidemiological studies. The department also studies health effects of the work environment to help identify potentially hazardous conditions prior to affecting the workers. A state-of-the-art computerized data base supports the medical programs.

58 GEOSCIENCES

Refer also to citation(s) 42346, 42567, 42643, 43031, 43284

43347 (BNL–43931) **Damage survey of the Northern California (Loma Prieta) earthquake of October 17, 1989.** Park, Y.J.; Philippacopoulos, A.J. Brookhaven National Lab., Upton, NY (USA). [1990]. 33p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90015411. Source: NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The October 17, 1989 Loma Prieta earthquake struck the Santa Cruz Mountains and San Francisco Bay area at 5:04 PM. This earthquake caused major damage in the epicentral area as well as in areas north of the epicenter. This report presents a summary of the damage survey performed by a reconnaissance team from Brookhaven National Laboratory. The damage survey was conducted during October 23–28, 1989. 5 refs., 11 figs.

43348 (CONF-9005149–6) **Geophysical diffraction tomography: A complementary remote sensing technique for hazardous waste site characterization.** King, W.C. (Fitzsimons Army Medical Center, Aurora, CO (USA)); Witten, A.J. Oak Ridge National Lab., TN (USA). [1990]. 13p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From 4. national outdoor action conference on aquifer restoration, groundwater monitoring, and geophysical methods; Las Vegas, NV (USA); 14-17 May 1990. Order Number DE90013025. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Use of surface geophysical methods for characterization of hazardous waste sites has well documented technical, health, and cost benefits when compared to intrusive data gathering methods. This statement is obviously predicated on the assumption that the geophysical methods being employed are applicable to the waste and shallow geologic features in the area of interest. This paper places a new surface geophysical technique, geophysical diffraction tomography, into a context of its utility within the existing remote sensing technology. A procedure based on analyses of the propagating wave which accounts for the naturally occurring diffractions has more information available than simple time of

travel, and therefore can provide information concerning subsurface features not recoverable from many existing surface sensing methods. The paper presents field results showing the application of the geophysical diffraction tomography method within the existing suite of remote sensing methods to maximize the site characterization information obtained. 18 refs., 4 figs., 1 tabs.

43349 (DOE/ER/60333–8) **California basin study (CaBS): Annual progress report, November 15, 1989–November 14, 1990.** Hickey, B.M. Washington Univ., Seattle, WA (USA). School of Oceanography. [1990]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-85ER60333. Order Number DE90015069. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Previous studies of geochemical recycling processes in the upper water column in the Southern California Bight focused on the seasonal cycle. Inspection of satellite sea surface color images as well as information from studies in other areas suggest that the cycling processes have significant variability on time scales of hours and days. To allow our seasonal studies to be examined in the context of the higher frequency variability, an interdisciplinary mooring was maintained near the midpoint of Santa Monica basin (known as station 305) from January to July, 1990. The Hickey group had the primary responsibility of deploying and recovering the mooring. The mooring consisted of a vector measuring wind recorder mounted above a toroidal buoy, below which were suspended two current/temperature recorders, a trnasmissometer, and two PAR sensors. The PAR sensors, which provide an estimate of phytoplankton growth rates, were deployed as part of the Trees proposal. At two additional nearby moorings, sediment traps were deployed at selected depths throughout the water column by Landry and by Soutar. To allow some investigation of lateral advection of material, current meters were deployed at the same depths as several of the sediment traps both at this site and also at the site farther along the basin axis. The data from these experiments have not yet been processed. 6 refs., 10 figs.

43350 **The Shallowater aubrite: Evidence for origin by planetesimal impacts.** Keil, K. (Univ. of New Mexico, Albuquerque (USA)); Ntaflos, Th.; Taylor, G.J.; Brearley, A.J.; Newsom, H.E.; Romig, A.D. Jr. *Geochimica et Cosmochimica Acta (USA)*, 53(12): 3291-3307 (Dec 1989).

In this paper the authors argue that Shallowater did not form on the aubrite parent body but represents yet an additional, fourth enstatite meteorite body. They further argue that its peculiar composition, texture, and cooling history can best be explained by an origin involving a low-velocity collision and break-up of a molten or partly molten asteroid, consisting largely of a melt of $MgSiO_3$ composition, with a solid, enstatite meteorite-like object. The fragments of liquid cooled very fast (hundreds of degrees per hour) due to incorporation of >20% cold projectile debris. The fragments reassembled while their temperature was somewhere above 712°C, and deeply buried objects cooled very slowly ($<7.5°C/10^6$ y) from 712 to 680°C. Subsequent excavation by impact(s) accounts for fast cooling (>0.5°C/day) from 680°C.

64 PHYSICS I

Refer also to citation(s) 43239

6401 Astrophysics and Cosmology

Refer also to citation(s) 43101, 43104, 43109, 43222, 43350, 43481, 43527, 43596

43351 (CBPF-NF–027/88) **Are Centauro events a manifestation of an unusual type of phase transition.** Predazzi, E. (Torino Univ. (Italy)); Beldiaga, I.; Curado, E.M.F. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 17p. Order Number DE90634892. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

It is argued that the Centauro events found in cosmic rays by the brazilian-japonese collaboration could be the manifestation of an unusual phase transition in which a new ordered phase of quarks separated from antiquarks takes place at extremely high densities. This new phase should then be followed by yet another disordered phase which might correspond to freeing the quark components. (author).

43352 (CBPF-NF–033/87) **Bulk-viscosity-driven asymmetric inflationary universe.** Waga, I. (Rio de Janeiro Univ., RJ (Brazil). Inst. de Fisica); Lima, J.A.S.; Portugal, R. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1987. 24p. Order Number DE90634866. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A primordial net bosinic charge is introduced in the context of the bulk-viscosity-driven inflationary models. The analysis is carried through a macroscopic point of view in the framework of the causal thermodynamic theory. The conditions for having exponetial and generalized inflation are obtained. A phenomenological expression for the bulk viscosity coefficient is also derived. (author).

43353 (CBPF-NF–070/87) **Non-equilibrium Friedmann cosmologies.** Oliveira, H.P. de (Universidade do Estado, Rio de Janeiro, RJ (Brazil)); Salim, J.M. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1987. 20p. Order Number DE90634867. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A uniform cosmological model filled with a fluid which possesses pressure and bulk viscosity is developed using extended thermodynamics. The Einsten and thermodynamic equations can be exactly integrated on Friedmann-like situation. One of the solutions is non singular: it starts from a steady state behavior and expands to a situation where viscosity dies out. (author).

43354 (CBPF-NF–072/88) **Inhomogeneous two-fluid cosmologies with electromagnetic field.** Nobre, M.A.S. (Rio de Janeiro Univ., RJ (Brazil). Inst. de Fisica); Lima, J. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 27p. Order Number DE90634868. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A new class of exact expanding inhomogeneous solutions of the Einstein-Maxwell equations is derived. These solutions generalize the dust filled models found by Ruban and the Doroshkevich "magnetic" universes. In the most general case the cosmological constant is non-zero and the matter content is a mixture of two interacting perfect fluids plus a sourceless electromagnetic field. The influence of the field near the singularity and at the latter stages of the expansion is examined. A subclass of the models approaches homogeneity and isotropy for large cosmological times. (author).

43355 (DOE/ET/53088–440) **Vlasov-Maxwell equilibria of solar Coronal loops.** Krishan, V. (Indian Inst. of Astrophysics, Bangalore (India)); Sreedharan, T.D.; Mahajan, S.M. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Jul 1990. 26p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–440). Order Number DE90015025. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A Vlasov-Maxwell description of the ubiquitous solar Coronal structures is presented. It is found that an equilibrium plasma configuration can live with spatial gradients in density, temperature, current, and drift speeds of the charged particles. Any stability study must be carried over this inhomogeneous equilibrium state. In addition, the Vlasov description admits the investigation of kinetic processes like heating and radiation.

43356 (INP–1370/PL, pp. 341-365) **The constancy of physics.** Irvine, J.M. (Manchester Univ. (UK). Dept. of Theoretical Physics). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Evidence restricting the variation of the coupling constants of nature is reviewed. Possible forms of gravitational coupling are examined. Particular attention is paid to data obtained from a study of prehistoric natural reactor at Oklo. The sensitivity of primordial nucleosynthesis to the values of coupling constants and masses is

studied. It is concluded that interaction strengths are constrained by the primordial isotopic abundances. 16 refs., 5 figs. (M.F.W.).

43357 (LA-UR–90-2365) **Pulsations of B star models by an opacity mechanism.** Cox, A.N. (Los Alamos National Lab., NM (USA)); Morgan, S.M. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005249–5: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014923. Source: NTIS, PC A02/MF A01 - OSTI.

The pulsation mechanism for B stars has been sought for 30 years. No proposed radial or nonradial mechanism, either deeply seated or in the surface layers, has been successful in explaining all the observational details. Perhaps the missing piece in the puzzle is the opacity of the stellar material. Many times the first author has tried to make unconventional surface compositions give instability, but none were ever found. We now propose that the sudden appearance of a tremendous number of iron lines, as the temperature rises above about 150,000 K, gives a high sensitivity of the opacity to temperature at the very low densities found in these blue giants. Opacities need to increase quickly to a factor of three or more above the Cox-Tabor (1976) values in the range around 200,000 K. These increases are the same needed to decrease theoretical period ratios of double-mode Cepheids and δ Scuti variables to agree better with observations for conventional yellow giant masses. The reason why not all B stars pulsate is that a slight primordial deficit in the iron abundance in the surface layer (1×10^{-6} of the mass) can reduce the opacity and its sensitivity to temperature. A slight amount of iron concentration by radiative levitation could make a star pulsate even if it did not originally have enough primordial iron to cause this opacity mechanism to operate. Then any slow slight mixing caused by the unstable nonradial pulsations could restabilize the pulsations as actually observed in α Vir and β CMa. Rapid levitation and mixing for the very luminous B stars with their very low density envelopes could even explain the puzzling luminous blue variables with this standard κ mechanism. Large amplitude pulsations like those seen in BW Vul would indicate a somewhat larger iron abundance compared to all other B stars.

43358 (LA-UR–90-2366) **Nonradial instability strips for post-AGB stars.** Stanghellini, L. (Osservatorio Astronomico di Bologna (Italy)); Cox, A.N.; Starrfield, S.G. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Management & Administration; National Science Foundation. DOE Contract W-7405-ENG-36. Grant: NSF 88-18215. (CONF-9005249–2: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014922. Source: NTIS, PC A02/MF A01 - OSTI.

We test several pre-degenerate (PNN and DO) and degenerate (DB) models for stability against nonradial oscillations. These models lie on the 0.6 $M_\odot$ evolutionary track calculated by Iben. The post-AGB stars have a residual CO core with only a little surface hydrogen and helium. In order to match all the observed pulsators. We use three different surface compositions for the DO stars, and a pure helium surface for the DB white dwarfs. We find 3 DO and 1 DB instability strips that we compare to the available observations. 16 refs., 1 fig.

43359 (LA-UR–90-2367) **Pulsations of the white dwarf component in V471 tauri-like binaries.** Stanghellini, L. (Osservatorio Astronomico di Bologna (Italy)); Cox, A.N.; Starrfield, S.G. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Management & Administration; National Science Foundation. DOE Contract W-7405-ENG-36. (CONF-9005249–1: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014921. Source: NTIS, PC A02/MF A01 - OSTI.

The eclipsing spectroscopic binary V471 Tau has a compact DA component that has been observed to pulsate with multimode, low amplitude oscillations. We test three models with different masses ($M/M_\odot$ = 0.6, 0.8, 1.0) against nonradial instability. Our models are derived from an evolutionary track calculated by Iben. The results confirm that the pulsations are driven by the κ and γ mechanisms operating in the ionization zones of carbon and oxygen. 18 refs., 1 fig., 1 tab.

43360 (LA-UR–90-2368) **Kappa effect pulsational instability for hot extreme helium stars.** Cox, A.N. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005249–4: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014920. Source: NTIS, PC A02/MF A01 - OSTI.

A long standing problem for the hydrogen deficient stars has been the mechanism for the pulsation instability for the hottest members of this class. The usual κ mechanism works well for stars that are in the hydrogen and helium ionization instability strip, and this strip extends to perhaps 20,000K at high luminosity. However, several stars are definitely hotter. Investigations for another ionization instability strip, such as for carbon, have always shown that there is not enough carbon to produce a rapid enough increase of opacity with temperature to give the well-known κ effect. This is so even though these hydrogen deficient stars do show enhanced carbon in their spectra. A strong stellar wind can produce the observed hydrogen deficiency. Another popular mechanism is mass loss in a binary system through the Roche lobe. It now is possible that the missing pulsational instability mechanism is the rapid increase of iron lines absorption as the temperature increases above about 150,000K in the low density envelopes of these luminous stars. Recent calculations shows that the n = 3 to n = 3 transitions in iron that were assumed unimportant in the earlier Los Alamos calculations can double or triple the opacity suddenly as the iron lines appear in a very sensitive part of the spectrum of the diffusing photons. It has been proposed that these iron lines also cause the many varieties of normal B star pulsations, and the hydrogen deficient stars are merely another example of this new κ effect for pulsating stars. The extreme helium star V2076 Oph at 31,900K, and 38,900 $L_\odot$ for a mass of 1.4 $M_\odot$ pulsates in the radial fundamental model at about 1 day period with a very large linear growth rate when the iron lines more than double the opacity, but is stable otherwise.

43361 (LA-UR–90-2369) **Cepheid masses for models with enhanced opacities.** Morgan, S.M. (Washington Univ., Seattle, WA (USA). Dept. of Astronomy); Cox, A.N. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005249–3: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014919. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Cepheid models with enhanced opacity are constructed and used to determine pulsation constants, Q_0. These are compared to models without an enhanced opacity. Methods of determining Cepheid masses are investigated using the different models and are compared to results obtained by Gieren. The methods to determine the pulsation and Wesselink masses by ourselves and Gieren differ significantly, due to the use of a Q_0 that varies with mass, radius and luminosity. 14 refs., 1 fig., 1 tab.

43362 (LA-UR–90-2370) **Solar oscillation frequency and solar neutrino predictions.** Cox, A.N. Los Alamos National Lab., NM (USA). 5 Jul 1990. 15p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005249–1: Confrontation between stellar pulsation and evolution, Bologna (Italy), 28-31 May 1990). Order Number DE90014918. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The light and velocity variations of the Sun and solar-like stars are unique among intrinsic variable stars. Unlike all other standard classes, such as Cepheids, B stars, and white dwarfs, the pulsation driving is caused by coupling with the acoustic noise in the upper convection zone. Each global pulsation mode is just another degree of freedom for the turbulent convection, and energy is shared equally between these g^--modes and the solar oscillation modes. This driving and damping, together with the normal stellar pulsation mechanisms produce extremely low amplitude solar oscillations. Actually, the surface layer radiative damping is strong, and the varying oscillation mode amplitudes manifest the stochastic convection driving and the steady damping. Thus stability calculations for solar-like pulsations are difficult and mostly inconclusive, but calculations of pulsation periods are as straightforward as for

all the other classes of intrinsic variable stars. The issue that is important for the Sun is its internal structure, because the mass, radius, and luminosity are extremely well known. Conventionally, we need the pulsation constants for each of millions of modes. Unknown parameters for constructing solar models are the composition and its material pressure, energy, and opacity, as well as the convection mixing length. We treat the nuclear energy and neutrino production formulas as sufficiently well known. The presence of weakly interacting massive particles (WIMPs) orbiting the solar center affects the predicted oscillation frequencies so that they do not agree with observations as well as those for models without WIMPs. 34 refs., 4 figs.

43363 (LA-UR–90-2372) **Nova LMC [Large Magellanic Cloud] 1990 No. 1: The first extragalactic neon Nova.** Sonneborn, G. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center); Shore, S.N. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Management & Administration; National Aeronautics and Space Administration; National Science Foundation. DOE Contract W-7405-ENG-36. Grant AST 88-18215;Grant NAG5-481;Grant NAG5-1393. (CONF-9005248–1: Evolution in astrophysics: IUE astronomy in the era of new space missions, Toulouse (France), 29 May - 1 jun 1990). Order Number DE90014917. Source: NTIS, PC A02/MF A01 - OSTI.

IUE observations of Nova LMC 1990 No. 1, the first neon (or ONeMg) nova observed outside the Galaxy, were obtained from 17 January 1990 through March 1990, with especially dense coverage during the first 25 days of the outburst. (The "neon" nova categorization is based on the detection of forbidden Ne III-V lines in optical spectra; the ultraviolet neon lines were not detected.) During the first 30 days of the outburst, the radiative losses were dominated by the N V λ1240 and C IV λ1550 lines. The maximum ejection velocity was approximately 8000 km/s, based on the blue absorption edge of the C IV P-Cygni profile. Early in the outburst of Nova LMC 1990 No. 1 the UV luminosity alone was $\sim 3 \times 10^{38}$ erg/sec, implying that the bolometric luminosity was well in excess of the Eddington luminosity for a one solar mass object. 9 refs., 4 figs.

43364 (LA-UR–90-2388) **PW Vul: A classical nova with nearly solar abundances.** Saizar, P. (Ohio State Univ., Columbus, OH (USA). Dept. of Astronomy); Ferland, G.J.; Wagner, R.M.; Austin, S.; Starrfield, S.; Truran, J.W. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. Grant AST88-18215;Grant NAG5-481;Grant AST87-19607. (CONF-9005248–3: Evolution in astrophysics: IUE astronomy in the era of new space missions, Toulouse (France), 29 May - 1 jun 1990). Order Number DE90014912. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Ultraviolet and optical spectrophotometric data were combined in order to determine the physical parameters in the expanding shell of Nova PW Vul 1984 No. 1. Ultraviolet data were obtained with the IUE satellite from August 2, 1984 (a few days after discovery) until it became too faint to study with the satellite. The last IUE exposure was obtained in June 1988 but we have continued to follow it with ground-based optical telescopes. We will present a plot that shows the variation of electron density and temperature as a function of time. Analysis of the emission line intensities show that the abundances of this very slow nova are solar for helium, carbon, and oxygen while nitrogen is 50 times solar. We have also used the CLOUDY code of Ferland to model the emission line intensities and find very good agreement with the observations. We shall display plots of representative IUE and optical spectra. 10 refs., 5 figs.

43365 (N–90-22371) **New calculations and measurements of the Coulomb cross-section for the production of direct electron pairs by high energy nuclei.** Derrickson, J.H.; Dake, S.; Dong, B.L.; Eby, P.B.; Fountain, W.F.; Fuki, M.; Gregory, J.C.; Hayashi, T.; Iyono, A.; King, D.T. National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center. 1989. 4p. (NASA-TM–101280;NAS–1.15:101280). Source: NTIS, PC A01/MF A01.

Recently, new calculations were made of the direct Coulomb pair cross section that rely less in arbitrary parameters. More accurate calculations of the cross section down to low pair energies were made. New measurements of the total direct electron pair yield, and the energy and angular distribution of the electron pairs in emulsion were made for O-16 at 60 and 200 GeV/amu at S-32 at 200 GeV/amu which give satisfactory agreement with the new calculations. These calculations and measurements are presented along with previous accelerator measurements made of this effect during the last 40 years. The microscope scanning criteria used to identify the direct electron pairs is described. Prospects for application of the pair method to cosmic ray energy measurements in the region 10 (exp 13) to 10 (exp 15) eV/amu are discussed.

43366 (N–90-22402) **Cyclotron maser and plasma wave growth in magnetic loops.** Hamilton, R.J.; Petrosian, V. Stanford Univ., CA (USA). May 1990. 30p. (NASA-CR–179862;NAS–1.26:179862). Source: NTIS, PC A03/MF A01.

Cyclotron maser and plasma wave growth which results from electrons accelerated in magnetic loops are studied. The evolution of the accelerated electron distribution is determined by solving the kinetic equation including Coulomb collisions and magnetic convergence. It is found that for modest values of the column depth of the loop the growth rates of instabilities are significantly reduced and that the reduction is much larger for the cyclotron modes than for the plasma wave modes. The large decrease in the growth rate with column depth suggests that solar coronal densities must be much lower than commonly accepted in order for the cyclotron maser to operate. The density depletion has to be similar to that which occurs during auroral kilometric radiation events in the magnetosphere. The resulting distributions are much more complicated than the idealized distributions used in many theoretical studies, but the fastest growing mode can still simply be determined by the ratio of electron plasma to gyrofrequency, $U=\omega_p/\Omega_e$. However, the dominant modes are different than for the idealized situations with growth of the z-mode largest for U approximately less than 0.5, and second harmonic x-mode (s=2) or fundamental o-mode (s=1) the dominant modes for 0.5 approximately less than U approximately less than 1. The electron distributions typically contain more than one inverted feature which could give rise to wave growth. It is shown that this can result in simultaneous amplification of more than one mode with each mode driven by a different feature and can be observed, for example, by differences in the rise times of the right and left circularly polarized components of the associated spike bursts.

43367 (N–90-22467) **Physics of systems containing neutron stars.** Shaham, J. Columbia Univ., New York, NY (USA). Nov 1989. 34p. (NASA-CR–186002;NAS–1.26:186002;CAL–1793). Source: NTIS, PC A03/MF A01.

Semiannual Technical Report, 1 Mar. - 31 Aug. 1989.

The following is a summary of work done during the period of Mar. to Oct. 1989. Three major topics were extensively looked into during this time: the reported 2,000 Hz optical signal from the direction of SNR1987A, the possibility that neutron stellar surface magnetic fields do not decay except when the star is accreting, and the 6 Hz QPOs of LMXBs.

43368 (N–90-22467, pp. 6) **Does SN 1987A contain a rapidly vibrating neutron star.** Wang, Q.; Chen, K.; Hamilton, T.T.; Ruderman, M.; Shaham, J. Columbia Univ., New York, NY (USA). Nov 1989. (NASA-CR–186002;NAS–1.26:186002;CAL–1793). In *Physics of systems containing neutron stars.* Source: NTIS, PC A03/MF A01.

If the recently reported 0.5 ms-period pulsed optical signal from the direction of Supernova 1987A originated in a young neutron star, its interpretation as a rotational period has difficulties. The surface magnetic field would have to be much lower than expected, and the high rotation rate may rule out preferred nuclear equations of state. It is pointed out here that a remnant radial vibration of a neutron star, excited in the supernova event, may survive for several years with about the observed (gravitationally redshifted) period. Heavy ions at the low-density stellar surface, periodically shocked by the vibration, may efficiently produce narrow pulses of optical cyclotron radiation in a surface field of about a trillion gauss.

43369 (N–90-22467, pp. 10) **Origin of pulsed emission from the young supernova remnant SN 1987A.** Ruderman, M.; Kluzniak, W.; Shaham, J. Columbia Univ., New York, NY (USA). Nov 1989. (NASA-CR–186002;NAS–1.26:186002;CAL–1793). In *Physics of systems containing neutron stars.* Source: NTIS, PC A03/MF A01.

To overcome difficulties in understanding the origin of the submillisecond optical pulses from SN 1987A a model similar to that of Kundt and Krotscheck for pulsed synchrotron emission from the Crab was applied. The interaction of the expected ultrarelativistic e(sup + or -) pulsar wind with the pulsar dipole electromagnetic wave reflected from the walls of a pulsar cavity within the SN 1987A nubula can generate pulsed optical emission with efficiency at most eta_{max} is approximately equal to 10(exp -3). The maximum luminosity of the source is reproduced and other observational constraints can be satisfied for an average wind energy flow is approximately equal to 10(exp 38) erg/(s steradian) and for electron Lorentz factor gamma is approximately equal to 10(exp 5). This model applied to the Crab yields pulsations of much lower luminosity and frequency.

43370 (N–90-22479) **Fast spectroscopic variations on rapidly-rotating, cool dwarfs. 3. Masses of circumstellar absorbing clouds on AB Doradus.** Cameron, A.C.; Duncan, D.K.; Ehrenfreund, P.; Foing, B.H.; Kuntz, K.D.; Penston, M.V.; Robinson, R.D.; Soderblom, D.R. Sussex Univ., Brighton (UK). Dec 1989. 79p. (NASA-CR–186563;NAS–1.26:186563). Source: NTIS, PC A05/MF A01.

New time-resolved H alpha, Ca II H and K and Mg II h and k spectra of the rapidly-rotating K0 dwarf star AB Doradus (= HD 36705). The transient absorption features seen in the H alpha line are also present in the Ca II and Mg II resonance lines. New techniques are developed for measuring the average strength of the line absorption along lines of sight intersecting the cloud. These techniques also give a measure of the projected cloud area. The strength of the resonance line absorption provides useful new constraints on the column densities, projected surface areas, temperatures and internal turbulent velocity dispersions of the circumstellar clouds producing the absorption features. At any given time the star appears to be surrounded by at least 6 to 10 clouds with masses in the range 2 to 6 x 10(exp 17) g. The clouds appear to have turbulent internal velocity dispersions of order 3 to 20 km/s, comparable with the random velocities of discrete filamentary structures in solar quiescent prominences. Night-to-night changes in the amount of Ca II resonance line absorption can be explained by changes in the amplitude of turbulent motions in the clouds. The corresponding changes in the total energy of the internal motions are of order 10(exp 29) erg per cloud. Changes of this magnitude could easily be activated by the frequent energetic (approximately 10(exp 34) erg) x ray flares seen on this star.

43371 (N–90-22522) **Slow shocks in coronal mass ejections.** Steinolfson, R.S. Texas Univ., Austin, TX (USA). 1989. 4p. (NASA-CR–186578;NAS–1.26:186578). Source: NTIS, PC A01/MF A01.

The possibility that slow-mode shock compression may produce at least some of the increased brightness observed at the leading edge of coronal mass ejections is investigated. Among the reasons given for the possible existence of slow shocks are the following: (1) transient velocities are often greater than the upstream sound speed but less than the Alfven speed, (2) the presence of a slow shock is consistent with the flat top observed in some transients, and (3) the lateral extension of slow shocks may be responsible for distributing adjacent structures as also seen on the observations. It is shown that there may be some difficulties with this suggestion for transients originating inside the closed-field region at the base of a preexisting coronal streamer. First of all, slow mode characteristics have difficulty emerging from the closed-field region at the streamer base so they can merge to form a slow shock, unless a preceding, large-amplitude disturbance opens the field lines. In addition, a slow shock cannot exist at the center of the streamer current sheet. Finally, numerical simulations demonstrate that at least the last two (and possibly all) of the above reasons for slow shocks can be satisfied by a disturbance whose leading edge propagates at the local fast-mode speed without any shocks. The leading portion of the transient that would be seen in white-light coronagraphs propagates at a speed either less than or equal to the fast-mode speed.

43372 (N–90-22526) **Gamma ray bursts: Current status of observations and theory.** Meegan, C.A. National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center. Apr 1990. 23p. (NASA-TM–100398;NAS–1.15:100398). Source: NTIS, PC A03/MF A01.

Gamma ray bursts display a wide range of temporal and spectral characteristics, but typically last several seconds and emit most of their energy in a low energy, gamma ray region. The burst sources appear to be isotropically distributed on the sky. Several lines of evidence suggest magnetic neutron stars as sources for bursts. A variety of energy sources and emission mechanisms are proposed.

43373 (N–90-23294, pp. 5-17) **Molecular clouds and the large-scale structure of the galaxy.** Thaddeus, P.; Stacy, J.G. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The application of molecular radio astronomy to the study of the large-scale structure of the Galaxy is reviewed and the distribution and characteristic properties of the Galactic population of Giant Molecular Clouds (GMCs), derived primarily from analysis of the Columbia CO survey, and their relation to tracers of Population 1 and major spiral features are described. The properties of the local molecular interstellar gas are summarized. The CO observing programs currently underway with the Center for Astrophysics 1.2 m radio telescope are described, with an emphasis on projects relevant to future comparison with high-energy gamma-ray observations. Several areas are discussed in which high-energy gamma-ray observations by the EGRET (energetic gamma-ray experiment telescope) experiment aboard the Gamma Ray Observatory will directly complement radio studies of the Milky Way, with the prospect of significant progress on fundamental issues related to the structure and content of the Galaxy.

43374 (N–90-23294, pp. 19-29) **The diffuse galactic gamma ray emission.** Bertsch, D.L. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The EGRET (energetic gamma-ray experiment telescope) detector will provide a much more detailed view of the diffuse galactic gamma ray intensity in terms of higher resolution, greater statistical significance, and broader energy range than earlier missions. These observations will furnish insight into a number of very important questions related to the dynamics and structure of the Galaxy. A diffuse emission model is being developed that incorporates the latest information on matter distribution and source functions. In addition, it is tailored to the EGRET instrument response functions. The analysis code of the model maintains flexibility to accommodate the quality of the data that is anticipated. The discussion here focuses on the issues of the distributions of matter, cosmic rays, and radiation fields, and on the important source functions that enter into the model calculation of diffuse emission.

43375 (N–90-23294, pp. 31-41) **A model of the diffuse galactic gamma ray emission.** Sreekumar, P. (Universities Space Research Association, Greenbelt, MD (USA)). National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The galaxy was observed to be a source of high energy gamma rays as shown by the two successful satellite experiments, SAS-2

and COS-B. It is generally understood that these diffuse gamma rays result from interactions between energetic cosmic rays and interstellar gas. This work makes use of the most recent data on the distribution of atomic and molecular hydrogen in the galaxy along with new estimates of gamma ray production functions to model the diffuse galactic gamma ray emission. The model allows various spatial distributions for cosmic rays in the Galaxy including non-axisymmetric ones. In the light of the expected data from EGRET (energetic gamma-ray experiment telescope), an improved model of cosmic ray-matter-gamma ray interaction will provide new insights into the distribution of cosmic rays and the strength of its coupling to matter.

43376 (N–90-23294, pp. 43-50) **Gamma rays from giant molecular clouds.** Hunter, S.D. (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany, F.R.)); Kanbach, G. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Giant Molecular Clouds (GMCs) are massive, bounded, cool, dense regions containing mostly H_2, but also H I, CO, and other molecules. These clouds occupy less than 1 percent of the galactic volume, but are a substantial part of the interstellar mass. They are irradiated by the high energy cosmic rays which are possibly modulated by the matter and magnetic fields within the clouds. The product of cosmic-ray flux and matter density is traced by the emission of high energy gamma-rays. A spherical cloud model is considered and the gamma ray flux from several GMCs within 1 kpc of the sun which should be detectable by the EGRET (Energetic Gamma-Ray Experimental Telescope) instrument on GRO (Gamma Ray Observatory).

43377 (N–90-23294, pp. 51-60) **Complementary information from mm-wave-, infrared-, and gamma ray astronomy.** Rothermel, H.; Cameron, M.; Eckart, A. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

An overview of the subdivision of wavelength ranges, importance of extinction, observing techniques, and scientific objectives in both IR broadband measurement and spectroscopy is given. Infrared and millimeter wave spectroscopy in the galaxy and IR and millimeter wave observations for Centaurus A are examined and discussed.

43378 (N–90-23294, pp. 61-77) **Implications of the IRAS data for galactic gamma ray astronomy and EGRET.** Stecker, F.W. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Using the results of gamma-ray, millimeter wave and far surveys of the galaxy, logically consistent picture of the large scale distribution of galactic gas and cosmic rays was derived, tied to the overall processes of stellar birth and destruction on a galactic scale. Using the results of the IRAS far-infrared survey of te galaxy, the large scale radial distributions of galactic far-infrared emission independently was obtained for both the Northern and Southern Hemisphere sides of the Galaxy. The dominant feature in these distributions was found to be a broad peak coincident with the 5 kpc molecular gas cloud ring. Evidence was found for spiral arm features. Strong correlations are evident between the large scale galactic distributions of far-infrared emission, gamma-ray emission and total CO emission. There is particularly tight correlation between the distribution of warm molecular clouds and far-infrared emission on a galactic scale. The 5 kpc ring was evident in existing galactic gamma-ray data. The extent to which the more detailed spiral arm features are evident in the more resolved EGRET (Energetic Gamma-Ray Experimental Telescope) data will help to determine more precisely the propagation characteristics of cosmic rays.

43379 (N–90-23294, pp. 81-87) **Radio pulsar timing observations for GRO.** Taylor, J.H. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Gamma rays probably provide the best diagnostic tool for probing the enigmatic physics of pulsar magnetospheres. At present, however, only two pulsars - the young, nearby ones in the Crab and Vela X supernova remnants - are reliably detected at gamma-ray energies. With adequate radio observations to provide independent timing information, Gamma Ray Observatory should be able to detect a number of additional pulsars, and the results will be of great benefit in testing magnetospheric theories and models. Timing observations for this purpose were started at a number of radio observatories around the world. The general procedures being used are described. A status report on the work is given.

43380 (N–90-23294, pp. 89-99) **Gamma radiation from radio pulsars.** Ruderman, M. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The probable magnetospheric location and source of the gamma ray emission from some young radiopulsars is discussed. The suggested evolution of this emission as a function of pulsar period gives a diminished gamma-ray luminosity for a more rapidly spinning pre-Crab pulsar. A greatly enhanced one, similar to that of unidentified Cos B sources, is predicted for a slightly slower post-Vela pulsar, followed by a relatively rapid quenching of the gamma-ray luminosity at still longer periods. Possible anomalous exo-magnetospheric pulsed MeV and TeV-PeV radiation from the Crab pulsar is considered.

43381 (N–90-23294, pp. 101-113) **Gamma radiation from the Crab and Vela pulsars.** Kanbach, G. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The young pulsars in Crab and Vela were observed as very efficient emitters of high energy gamma radiation. While their radiation in the radio, optical, and x ray range was always known to differ considerably, the gamma ray emission on a superficial level appears quite similar: lightcurves with two narrow peaks, separated by 141 deg (Crab) and 153 deg (Vela) and photon energies in excess of 1 GeV with spectra that can be described by a power-law for Crab and a broken power-law for Vela. The detailed observations of these sources with the COS-B instrument, extending over nearly seven years, have revealed significant differences in the characteristics of the pulsars in the gamma-ray domain. Secular changes in the temporal (Crab) and spectral (Vela) properties above 50 MeV were found. These tantalizing signatures of the pulsar emission processes must now be explored in more detail and over a larger spectral range with the GRO (Gamma Ray Observatory) instruments in order to gain a deeper understanding of the physics of young neutron stars.

43382 (N–90-23294, pp. 115-124) **Gamma ray pulsars: Models and observations.** Thompson, D.J. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space

Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The two known gamma ray pulsars, the Crab and Vela, were used as guides for the development of models of high-energy radiation from spinning neutron stars. Two general classes of models were developed: those with the gamma radiation originating in the pulsar magnetosphere far from the neutron star surface (outer gap models) and those with the gamma radiation coming from above the polar cap (polar cap models). The goal is to indicate how EGRET can contribute to understanding gamma-ray pulsars, and especially how it can help distinguish between models for emission.

43383 (N–90-23294, pp. 135-143) **TeV radiation from the Crab nebula and other matters.** Lamb, R.C. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The detection of the Crab Nebula via the Cherenkov imaging technique places TeV astronomy on a secure observational footing. The motivation for TeV observations, a discussion of the atmospheric Cherenkov technique, the experimental details of the Crab Nebula detection, and its scientific implications are presented. The present dilemma of VHE/UHE astronomy is that the Crab appears to be the only source whose showers match theoretical expectations. The situation will be clarified as improved ground-based detectors come on-line with sensitivities matching those of the GRO (Gamma Ray Observatory) instruments.

43384 (N–90-23294, pp. 145-151) **The Illusive Geminga: What is It.** Kniffen, D.A. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The first unassociated gamma-ray source was discovered by SAS-2 in 1973 (Kniffen, et al., 1975) and later confirmed by COS-B (Bennett, et al., 1977). Followed the announcement, there were numerous attempts to find a counterpart, and many models were developed to explain the source. Now over fifteen years later this illusive source still remains as one of the major riddles of astrophysics. The question of why an object, which is able to emit such energetic photons is so well concealed at other wavelengths, still remains to be answered. The association with the Einstein source 1E 0630+178 is the most favored (Bignami, Caraveo, and Lamb, 1983), but this cannot be considered proven. The pulsar emission model of Ruderman and Cheng (1988) is appealing in its broad applicability, but awaits observational confirmation. The EGRET (Energetic Gamma-Ray Experimental Telescope) instrument on the Gamma-Ray Observatory provides a major improvement in observational capability to better define the location and spectrum of this source, and hopefully leads to a confident identification.

43385 (N–90-23294, pp. 153-159) **COS-B gamma ray sources beyond the predicted diffuse emission.** Mayer-Hasselwander, H.A. (New Hampshire Univ., Durham (USA)); Simpson, G. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

COS-B data were reanalyzed using for background subtraction the modeled galactic diffuse gamma-ray emission based on HI- and CO-line surveys and the gamma-ray data itself. A methodology was developed for this purpose with the following three features: automatic generation of source catalogs using correlation analysis, simulation of trials to derive significance thresholds for source detection, and bootstrap sampling to drive error boxes and confidence intervals for source parameters. The analysis shows that about half of the 2CG sources are explained by concentrations in the distribution of molecular hydrogen. Indication for a few weak new sources is also obtained.

43386 (N–90-23294, pp. 161-177) **More data on (possible) gamma ray (point) sources.** Hermsen, W. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The 2CG catalog of gamma ray sources was compiled before detailed knowledge was available on the fine-scale structure of the diffuse Galactic gamma-ray emission. Two independent analyses to discriminate sources which are either compact objects of due to very local and strong enhancements in the Galactic cosmic-ray distribution from those which are artifacts due to the clumpy gas distribution are about to be completed: a maximum likelihood analysis and a cross correlation analysis. Arguments are given why differences, and therefore confusion, and in resulting source lists can be expected. Detailed analysis of all COS-B gamma-ray data on Geminga (2CG195+04), reveals the existence of a drastic spectral break below 200 MeV. A power-law spectrum with index -1.88 fits the data above about 100 MeV to 3.2 GeV, however, there are also indications for a spectral break above these energies. For energies above about 100 MeV no evidence for a long-term time variability was found. The error region of Geminga was searched for a radio counterpart at wavelengths of 90, 49, 21, 6, and 2 cm using the Westerbork Synthesis Radio Telescope and the Very Large Array. So far, 16 sources were detected in this error region. In the direction of 1E0630+178, the Einstein x ray source proposed to be a Vela-like pulsar and the counterpart of Geminga, no radio source was found at 21, 49, and 90 cm with 3 sigma upper limits on the flux densities ranging from 0.5 mJy at 21 cm to 4.5 mJy at 90 cm. Detailed structures in local molecular cloud complexes are so far only resolved in gamma rays for the closet and most massive complexes, namely those in the Orion-Monoceros and the Ophiuchus regions. For both region, there is circumstantial evidence for gamma ray emission from molecular gas that was photodissociated after the passage of a SN shell.

43387 (N–90-23294, pp. 179-182) **What can gamma rays tell us about binary x ray sources and SNR's.** Ulmer, M.P. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Black holes, neutron stars in binary x ray source systems, and supernova remnants (SNRs) are briefly discussed.

43388 (N–90-23294, pp. 183-199) **Gamma rays from pulsar wind shock acceleration.** Harding, A.K. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

A shock forming in the wind of relativistic electron-positron pairs from a pulsar, as a result of confinement by surrounding material, could convert part of the pulsar spin-down luminosity to high energy particles through first order Fermi acceleration. High energy protons could be produced by this mechanism both in supernova remnants and in binary systems containing pulsars. The pion-decay gamma-rays resulting from interaction of accelerated protons with

surrounding target material in such sources might be observable above 70 MeV with EGRET (Energetic Gamma-Ray Experimental Telescope) and above 100 GeV with ground-based detectors. Acceleration of protons and expected gamma-ray fluxes from SN1987A, Cyg X-3 type sources and binary pulsars are discussed.

43389 (N–90-23294, pp. 201-213) **Spectral determinations for discrete sources with EGRET.** Hughes, E.B.; Nolan, P.L. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The ability of the EGRET (Energetic Gamma-Ray Experimental Telescope) to determine the spectral parameters of point sources in 14-day exposures, as planned for the initial survey phase of the GRO (Gamma Ray Observatory) mission, is explored by numerical simulation. Results are given for both galactic and extragalactic objects as a function of source strength and for representative levels of diffuse background emission.

43390 (N–90-23294, pp. 217-231) **Gamma ray bursts: Current status of observations and theory.** Meegan, C.A. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Gamma-ray bursts display a wide range of temporal and spectral characteristics, but typically last several seconds and emit most of their energy in the low-energy gamma-ray region. The burst sources appear to be isotropically distributed on the sky. Several lines of evidence suggest magnetic neutron stars as sources for bursts. A variety of energy sources and emission mechanisms were proposed.

43391 (N–90-23294, pp. 233-242) **What is learned from high energy bursts and flares.** Schneid, E.J. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The Energetic Gamma Ray Experiment Telescope (EGRET) with its large NaI Total Absorption Shower Counter (TASC) has the scientific capability of performing spectroscopy of high energy cosmic gamma ray bursts and solar flares. EGRET, with a spectroscopy energy range from 0.6 to 140 MeV, provides an opportunity to increase the understanding of the high energy mechanisms of gamma ray bursts and solar flares. A likely interpretation of gamma ray burst sources is that they are rotating, magnetized neutron stars. High magnetic fields can influence the emission of high energy gamma rays, so observational spectroscopic data at high energies can provide information on the upper limits of the magnetic fields in the GRB regions of magnetized neutron stars. Likewise, spectroscopy of high energy gamma rays can provide information useful for deriving the flare proton spectrum which in turn can lead to an understanding of high energy solar flare particle acceleration mechanisms.

43392 (N–90-23294, pp. 245-256) **Local normal galaxies.** Fichtel, C.E. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

In the near future, high energy (E greater than 20 MeV) gamma ray astronomy offers the promise of a new means of examining the closest galaxies. Two and possibly three local galaxies, the Small and Large Magellanic Clouds and M31, should be visible to the high energy gamma ray telescope on the Gamma Ray Observatory, and the first should be seen by GAMMA-1. With the assumptions of adequate cosmic ray production and reasonable magnetic field strengths, both of which should likely be satisfied, specific predictions of the gamma ray emission can be made separating the concepts of the galactic and universal nature of cosmic rays. A study of the synchrotron radiation from the Large Magellanic Cloud (LMC) suggests that the cosmic ray density is similar to that in the local region of our galaxy, but not uniform. It is hoped the measurements will be able to verify this independent of assumptions about the magnetic fields in the LMC.

43393 (N–90-23294, pp. 259-275) **Gamma rays from active galactic nuclei.** Kazanas, D. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The general properties of Active Galactic Nuclei (AGN) and quasars are reviewed with emphasis on their continuum spectral emission. Two general classes of models for the continuum are outlined and critically reviewed in view of the impending GRO (Gamma Ray Observatory) launch and observations. The importance of GRO in distinguishing between these models and in general in furthering the understanding of AGN is discussed. The very broad terms the status of the current understanding of AGN are discussed.

43394 (N–90-23294, pp. 277-287) **Spectral evolution of active galactic nuclei Penrose Compton scattering processes and gamma ray emission from Seyfert galaxies.** Leiter, D.; Boldt, E. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

In black hole spectral evolution models for active galactic nuclei (AGN), present epoch Seyfert galaxies evolve from an earlier precursor active galaxy (PAG) stage at redshift z is approximately 7 where they acted as the thermal sources responsible for the residual cosmic x ray background (RCXB). The Seyfert galaxies which emerge in this context emit Penrose Compton Scattering (PCS) gamma ray transients on the order of hours with a kinematic cutoff in the spectrum less than or equal to 3 MeV. The EGRET (Energetic Gamma-Ray Experimental Telescope), OSSE (Oriented Scintillation Spectrometer Experiment), COMPTEL (Compton Telescope), BATSE (Burst and Transient Source Experiment) instruments on the Gamma Ray Observatory (GRO) are appropriate instruments to carry out further tests of this model by studying: PCS gamma ray transient emission from individual galaxies and, the possibility that present epoch PCS gamma ray emitting Seyfert galaxies contribute observable temporal variability to the excess diffuse gamma ray background component less than or equal to 3 MeV.

43395 (N–90-23294, pp. 289-301) **The high energy source 3C 273.** Vonmontigny, C. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The properties of 3C 273 are reviewed and an attempt is made to find an answer to the question why 3C 273 is the only extragalactic source so far, which was detected at energies greater than or equal to 50 MeV.

43396 (N–90-23294, pp. 303-309) **COMPTEL observations of active galactic nuclei.** Schonfelder, V. National Aeronautics

and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The number of AGNs (Active Galactic Nuclei) that might be observed by COMPTEL (Compton Telescope) around 1 MeV is of the order of two dozens or less. The estimate is based on the HEAO-1 (High Energy Astronomy Observer) measurements between 2 keV and 100 keV and on the assumption that the power law spectra of AGNs at x ray energies extend to at most 3 MeV before they break off.

43397 (N–90-23294, pp. 311-316) **OSSE observations of active galactic nuclei.** Johnson, W.N. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The Oriented Scintillation Spectrometer Experiment (OSSE) was designed to address a broad range of scientific objectives through gamma ray observations in the 0.05 to 10 MeV energy range. A significant number of these observations shall be directed to the study of Active Galactic Nuclei (AGN). The characteristics of the OSSE instrument and the current observation plans are discussed. Examples of the scientific issues which OSSE expects to address are provided.

43398 (N–90-23294, pp. 319-327) **Gamma ray cosmology: The extra galactic gamma spectrum and methods to detect the underlying source.** Cline, D.B. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

The possible sources of extragalactic gamma rays and methods to distinguish the different sources are discussed. The sources considered are early universe decays and annihilation of particles, active galactic nuclei (AGN) sources, and baryon-antibaryon annihilation in a baryon symmetric cosmology. The energy spectrum and possible angular fluctuations due to these sources are described.

43399 (N–90-23294, pp. 329-332) **Dipole analysis on EGRET data of extragalactic gamma ray background radiation.** Lin, Yingchi. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

A dipole analysis on the EGRET (Energetic Gamma-Ray Experimental Telescope) data seems to be one of the numerous subjects that can be investigated for the extragalactic gamma ray background radiation. By the end of the first one and half years after launch, the all-sky survey program of GRO (Gamma Ray Observatory) will be completed. The EGRET detector will cover the full sky area fairly well by that time. A set of gamma ray data suitable for dipole moment calculations will be available. Furthermore, there now exist in the literature several dipole anisotropy results calculated for optical and infrared observations on the distribution of galaxies in the full sky. The results of dipole moment analysis from gamma ray observation can be compared with those at other wavebands, and hopefully some deeper understanding can be gained on the large scale structure of the Universe.

43400 (N–90-23294, pp. 333-342) **Feasibility for EGRET detection of antimatter concentrations in the universe.** Hartman, R.C. National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center. May 1990. (NASA-CP–3071;NAS–1.55:3071;CONF-8911215–: EGRET: energetic gamma-ray experiment telescope science symposium, Greenbelt, MD (USA), 15-16 Nov 1989). In *The energetic gamma-ray experiment telescope (EGRET) science symposium.* Source: NTIS, PC A15/MF A02; 1 functional color page.

Although the Grand Unified Theories of elementary particle dynamics have to some extent reduced the aesthetic attraction of matter-antimatter symmetry in the Universe, the idea is still not ruled out. Although first introduced by Alfven (1965), most of the theoretical development related to gamma-ray astronomy was carried out by Stecker, who has proposed (Stecker, Morgan, and Bredekamp, 1971) matter-antimatter annihilation extending back to large redshifts as a possible explanation of the apparently extragalactic diffuse gamma radiation. Other candidate explanations were also proposed, such as superposition of extragalactic discrete sources. Clearly, the existence of significant amounts of antimatter in the universe would be of great cosmological importance; its detection, however, is not simple. Since the photon is its own antiparticle, it carries no signature identifying whether it originated in a matter or an antimatter process; even aggregates of photons (spectra) are expected to be identical from matter and antimatter processes. The only likely indicator of the presence of concentrations of antimatter is evidence of its annihilation with normal matter, assuming there is some region of contact or overlap. The EGRET (Energetic Gamma-Ray Experimental Telescope) on the Gamma Ray Observatory, with a substantial increase in sensitivity compared with earlier high energy gamma ray telescopes, may be able to address this issue. The feasibility of using EGRET in such a search for antimatter annihilation in the Universe is considered.

43401 (SAAO–12) **The South African Astronomical Observatory: Report for year ending 31 December 1987.** South African Astronomical Observatory, Cape Town (South Africa). 1988. 47p. Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

The geographical position, climate and equipment at the South African Astronomical Observatory (SAAO), together with the enthusiasm and efforts of SAAO scientific and technical staff and of visiting scientists, have enabled the Observatory to make a major contribution to the fields of astrophysics and cosmology. During 1987 the SAAO has been involved in studies of the following: supernovae; galaxies, including Seyfert galaxies; celestial x-ray sources; magellanic clouds; pulsating variables; galatic structure; binary star phenomena; nebulae; interstellar matter and stellar astrophysics.

43402 (SAAO–12, pp. 12-15) **Ground based observations of celestial x-ray sources.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

During the period covered by this report many ground based observations of celestial x-ray sources were undertaken by the South African Astronomical Observatory. Observations were made of the following: the intermediate Polar EX Hydrae; the intermediate Polar TV Col; the AM Her system E1405-451; the AM Her system H0139-68; the X-ray pulsar 4U1145-619, as well as other x-ray sources. Calculations of gyrosynchrotron absorption coefficients were also made. 3 figs.

43403 (SAAO–12, pp. 15-19) **Pulsating variables.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

The complex pulsations found in certain stars are capable of yielding much information on the internal structure of the star. Examples of such stars are: Beta Cephei; Delta Scuti; ZZ Ceti and RR Lyrae stars, and during the year studies on these stars were carried out. The study of oscillating Ap stars continued and extensive searches were made for new Rapidly Oscillating Ap stars. The discovery of short-period variations in many Be stars aroused great interest. Work on galactic cepheids continued and the intrinsic

properties of cepheids and dwarf cepheids were examined in detail. 4 figs.

43404 (SAAO–12, pp. 19-21) **Galactic structure.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

A central concentration of stars (the 'bulge') is a prominant feature of our own and other galaxies. It has long been known that there are planetary nebulae amongst the bulge population in our galaxy. In an investigation of the structure of our galaxy, new planetary nebulae have been discovered and studied in the region of the central bulge. Clear evidence has been found for a rotation of the bulge system, while the physical parameters of the bulge planetaries are found to conform the conclusion reached earlier at the South African Astronomical Observatory (SAAO) that the vast bulk of the bulge population is older than 5x10'9 years. Evidence for 'missing mass' has steadily accumulated on a wide variety of distance scales. The implications of these observations for the problem of missing mass in the solar neighbourhood has been studied. Although the numbers so far detected are insufficient to make up the deficit, there is reason to believe that it may reside in yet fainter stars or substellar objects. Surveys were also undertaken of the South Galactic Cap and field faint blue stars. 1 fig.

43405 (SAAO–12, pp. 21-26) **Binary star phenomena.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

Binary star phenomena were also investigated by the South African Astronomical Observatory during the year. The following were examined in detail: the recurrent Nova U Sco, and other recurrent novae; the dust shells of Nova Cen 1986 and Nova Sgr 1987; certain cataclysmic variables; calcium emission line stars; the interacting binary white dwarf V803 Cen, as well as a number of other binaries; and symbiotic stars. 7 figs.

43406 (SAAO–12, pp. 26-28) **Nebulae and interstellar matter.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

Despite many years of theoretical interest in star formation and the collapse of protostellar clouds, there are still important aspects of this process which are not understood. It is for this reason that the South African Astronomical Observatory examined the following: the magnetic fields and star formation in the Serpens Nebula; the Chamaeleon infrared nebula; the binary central star, LSS 2018, of the planetary nebula DS-1; the planetary nebula NGC 3918, and a nebulous star cluster, as well as various aspects of nebulosity and star formation in general. 2 figs.

43407 (SAAO–12, pp. 28-31) **Stellar astrophysics.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

Enhanced mass loss occurs at critical stages in the evolution of stars over a wide range of stellar mass. Observationally, these stages are difficult to identify because of their short duration and because the star is often obscured by dust which condenses in the ejecta. A study of a G-type star, of which only the outer envelope was directly visible, was undertaken by the South African Astronomical Observatory (SAAO). The star itself was obscured by dust clouds and its light was only feebly seen by reflection from some of these clouds. Other studies of the galaxy undertaken by the SAAO include observations of the following: the extreme carbon star IRAS 15194-5115; RV Tauri and T Tauri stars; pre-main sequence stars; the properties of circumstellar dust; rotational modulation and flares on RS CVn and BY Dra stars; heavy-element stars; hydrogen-deficient stars; the open cluster NGC6192; stars in Omega Centauri, and lunar occulations of stars. Simultaneous x-ray, radio and optical data of the flare star YZ CMi were also obtained. 1 fig.

43408 (SAAO–12, pp. 8-12) **Galaxies.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

To study and understand the distribution and motions of galaxies in the universe is one of the greatest goals of astronomy. In recent times there has been an awareness that even on the very large scale galaxies do not seem to be distributed uniformly in space. A study of the distribution in space and in velocity of elliptical galaxies was undertaken by the South African Astronomical Observatory (SAAO). Nearly 2000 photometric measures were made for this project. When this data is combined with new radial velocities it unexpectedly indicates large streaming motions (≈600 km/sec) with respect to the smooth expansion of the universe. This has led to the concept of a 'Great Attractor' some $2x10^8$ light years from earth. Another large project on the distribution and motions of galaxies is the redshift survey of 2028 galaxies in a limited region of the southern sky. The data can be interpreted as showing large deviations from a uniform distribution of galaxies in space with empty regions about 10^8 light years across. Other aspects examined by the SAAO include: the BL Lac-type quasar; optical and infrared observations of IRAS galaxies; Seyfert galaxies and the Fornax cluster of galaxies. 3 figs.

43409 (SAAO–12, pp. 15) **The magellanic clouds.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

Short note. MAGELLANIC CLOUDS; CARBON STARS; CARBON 12; CARBON 13; CEPHEIDS; PHOTOMETRY; SPECTROSCOPY; VARIABLE STARS

43410 (SAAO–12, pp. 5-8) **Supernovae.** South African Astronomical Observatory, Cape Town (South Africa). 1988. In *The South African Astronomical Observatory: Report for year ending 31 December 1987.* Source: Available from the South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa.

The processes at work in supernovae are of importance to nuclear and particle physics and the study of highly condensed matter, as well as being central to problems in astrophysics and cosmology. For this reason, observations of SN 1987A in the Large Magellanic Cloud, the brightest supernovae for nearly 400 years, have excited great interest in the international scientific community. The geographical position, climate and equipment at the South African Astronomical Observatory (SAAO) have enabled the Observatory to make a major contribution to the study of this object. In particular SAAO has obtained a much more extensive set of observations of the light variations of the supernova, at a wide range of optical and infrared wavelengths, than has been possible elsewhere. Amongst the direct results of this work is the striking verification of the theoretical prediction that the late stages of supernova evolution are powered by radioactive heating from the unstable nucleus ^{56}Co. 7 figs.

43411 Particle physics in the cosmos - Readings from Scientific American Magazine. Carrigan, R.A. Jr.; Trower, W.P. 235p. W. H. Freeman and Co., New York, NY (US) (1989).

The cosmological implications of current particle-physics theory are explored in a collection of reviews for general readers, originally published during the period 1974-1986. Topics addressed include dark matter in the universe, the structure of the early universe, the large-scale structure of the universe, a unified theory of elementary particles and forces, and gauge theories of the forces between elementary particles. Consideration is given to theoretical models and observational searches for proton decay, superheavy magnetic monopoles, deuterium in the universe, the cosmic asymmetry between matter and antimatter, the inflationary universe, and

the future of the universe. Diagrams, graphs, and sample images are provided.

43412 Fast pulsars, strange-quark-matter stars. Glendenning, N.K. (Lawrence Berkeley Lab., CA (USA)). pp. 14, Paper NUCL 42 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The authors show that rotation periods of about a millisecond distinguish between pulsars that can be understood as neutron stars and those that cannot. Those having shorter periods, of which the 1/2 ms pulsar reported in SN1987A is the first example, must be formed of such dense matter than the constituents cannot be individual hadrons: Sub-millisecond pulsars cannot be neutron stars. Such pulsars are most easily understood as stable self-bound objects, unlike all other known stars which are bound by gravity alone. The only plausible candidate for their composition is strange-quark-matter. The reasons for these conclusions, the implications, properties, relationship between neutron stars and strange stars, and conversion from one to the other, will be discussed.

43413 Recent results from the homestake - Pennsylvania solar neutrino experiment. Davis, R. Jr. (Univ. of Pennsylvania, Philadelphia (USA)); Lande, K.; Lee, C.K.; Cleveland, B.T.; Ullman, J. pp. 17, Paper NUCL 56 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The radiochemical solar neutrino experiment in the Homestake Gold Mine has monitored the flux of solar neutrinos over the period 1970 to the present time. The flux of solar neutrinos shows a variation in time that anti-correlates with the sunspot cycle. These observations will be compared with solar model calculations, the Sun's magnetic field and the properties of neutrinos. The implications of the effect on other solar neutrino detectors will be discussed.

43414 Sudbury Neutrino Observatory. Wilhelmy, J.B. (Los Alamos National Lab., NM (USA)). pp. 18, Paper NUCL 57 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The Sudbury Neutrino Observatory (SNO) has, as a primary objective, the study of the neutrino production in the sun. The experiment will attempt to resolve the long standing puzzle associated with the observation of an abnormally low fluence of high energy electron neutrinos. Though more conventional explanations for this discrepancy can not be totally eliminated, a new mechanism has been recently proposed in which the electron neutrinos produced in the ^{8}B decay might be converted into other neutrino types during passage through the dense stellar medium. The SNO detector will consist of 1,000 tons of D_2O located 6,800 feet underground in the Creighton mine near Sudbury, Ontario. This will be the first solar neutrino detector capable of measuring the three neutrino interactions: scattering, charged current, and neutral current. The current status of the experiment will be presented with special emphasis placed on the neutral current measurements.

43415 Characterization of lunar ilmenite resources. Heiken, G.H.; Vaniman, D.T. pp. 239-247 of Lunar and Planetary Science Conference, 20th, Houston, TX, Mar. 13-17, 1989, Proceedings. Sharpton, V.L.; Ryder, G. Lunar and Planetary Institute, Houston, TX (US) (1990). (CONF-8903111--: Lunar planetary science conference, Houston, TX (USA), 12-18 Mar 1989).

Ilmenite will be an important lunar resource, to be used mainly for oxygen production but also as a source of iron. Ilmenite abundances in high-Ti basaltic lavas are higher (9-19 vol pct) than in high-Ti mare soils (mostly less than 10 vol pct). This factor alone may make crushed high-Ti basaltic lavas most attractive as a target for ilmenite extraction. Concentration of ilmenite from either a crushed basalt or regolith requires size sorting to avoid polycrystalline fragments. In coarse-grained high-Ti basaltic lavas, about 60-80 percent of the ilmenite will consist of relatively 'clean' single crystals if the rocks are crushed to a size of 0.2 mm. Fine-grained high-Ti basalts, with thin skeletal or hopper-shaped ilmentes, would produce essentially no free or 'clean' ilmenite grains even if crushed to 0.15 mm and only about 7 percent free ilmenite if crushed to 0.05 mm. Data from the 2.8-m-thick regolith sampled by coring at the Apollo 17 site show that in even the most basalt-clast-rich and least mature stratigraphic intervals, free ilmenite grains make up less than 2 percent of the 0.02- to 0.2-mm size fraction and a mere 0.3 percent of the 0.2- to 2-mm size fraction. 26 refs.

43416 Synchrotron X-ray fluorescence analyses of stratospheric cosmic dust - New results for chondritic and low-nickel particles. Flynn, G.J.; Sutton, S.R. pp. 335-342 of Lunar and Planetary Science Conference, 20th, Houston, TX, Mar. 13-17, 1989, Proceedings. Sharpton, V.L.; Ryder, G. Lunar and Planetary Institute, Houston, TX (US) (1990). (CONF-8903111--: Lunar planetary science conference, Houston, TX (USA), 12-18 Mar 1989).

Trace element abundance determinations were performed using synchrotron X-ray fluorescence on nine particles collected from the stratosphere and classified as cosmic. Improvements to the Synchrotron Light Source allowed the detection of all elements between Cr and Mo, with the exceptions of Co and As, in our largest particle. The minor and trace element abundance patterns of three Ni-depleted particles were remarkably similar to those of extraterrestrial igneous rocks. Fe/Ni and Fe/Mn ratios suggest that one of these may be of lunar origin. All nine particles exhibited an enrichment in Br, ranging from 1.3 to 38 times the C1 concentration. Br concentrations were uncorrelated with particle size, as would be expected for a surface correlated component acquires from the stratosphere. 31 refs.

43417 A model for the distribution of the intergalactic medium. Ryu, Dongsu (NASA/Fermilab Astrophysics Center, Batavia, IL (USA)); Vishniac, E.T.; Chiang, Wwihwan. *Astrophysical Journal (USA)*, 354: 389-399 (May 1990).

The evolution and distribution of the intergalactic medium (IGM) in a universe dominated by cold dark matter with Omega(0) = 1 and h = 0.5 are investigated. Galaxies form and eject energy into the IGM from z about 20 up to the present, and the distribution of the IGM is dominated by large connected structures. The power spectrum and two-point correlation function of the IGM show a suppressed growth due to the energy injected from galaxies and the mass subtraction to form galaxies. The high-temperature regions of the IGM correspond to the low-density regions and the low-temperature regions correspond to the high-density regions. The temperature of the IGM increases from z = 1 to z = 0, while the prsssure decreases. The present temperature distribution shows a peak at about 10 million K. The mass fraction of the IGM with temperature below 100,000 K is negligible, indicating almost all the hydrogen is ionized. 29 refs.

43418 Dark matter and thermal pulses in horizontal-branch stars. Dearborn, D. (Lawrence Livermore National Laboratory, CA (USA)); Raffelt, G.; Salati, P.; Silk, J.; Bouquet, A. *Astrophysical Journal (USA)*, 354: 568-582 (May 1990).

The evolution of horizontal-branch (HB) stars, including the effect of energy transfer by dark matter particles ('WIMPs' or 'cosmions') is investigated numerically. If HB stars contain enough cosmions to break core convection, thermal pulses ensue on the core Kelvin-Helmholtz time scale until the central helium abundance is exhausted. These pulses involve brief phases of violent helium burning which establish short episodes of convection where the convective core extends further than it would in the absence of cosmions. The overall duration of the HB phase slightly decreases, and the luminosity dispersion of the HB increases, but neither effect is pronounced enough to conflict with observations. The magnitude difference between the HB and the main-sequence turnoff increases and leads to an overestimate of globular cluster ages. The observed period changes of RR Lyrae stars are consistent with, and even implied by, this scenario. 49 refs.

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 42331, 42978, 42994, 43020, 43049, 43070, 43090, 43111, 43219, 43221, 43474, 43564, 43595, 43597

43419 (BNL–44534) **Beam-line considerations for experiments with highly-charged ions.** Johnson, B.M. Brookhaven National Lab., Upton, NY (USA). [1990]. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-9003154–3: Workshop on atomic physics at the Advanced Photon Source, Argonne, IL (USA), 23-30 Mar 1990). Order Number DE90011515. Source: NTIS, PC A03/MF A01; OSTI; INIS.

The APS offers exciting possibilities for a bright future in x-ray research. For example, measurements on the inner-shell photoionization of ions will be feasible using stored ions in ions traps or ion beams from an electron-cyclotron-resonance ion source, or perhaps even a heavy-ion storage ring. Such experiments with ionic targets are the focus for the discussion given here on the optimization of photon flux on a generic beamline at the APS. The performance of beam lines X26C, X26A, and X17 on the x-ray ring of the National Synchrotron Light Source will be discussed as specific examples of beam-line design considerations.

43420 (DOE/ER/13778–3) **Correlated charge changing ion-atom collisions: Progress report, February 15, 1987–February 15, 1990.** Bernstein, E.M.; Tanis, J.A. Western Michigan Univ., Kalamazoo, MI (USA). Feb 1990. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13778. Order Number DE90014662. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report summarizes the progress and accomplishments in accelerator atomic physics research supported by DOE grant FG02-87ER13778 from August 15, 1987 through February 15, 1990. The general scope of this work involves the experimental investigation of fundamental atomic interactions in collisions of highly charged projectiles with neutral targets, with a particular emphasis on two-electron interactions. Inner-shell processes involving excitation, ionization, and charge transfer are investigated using, for the most part, coincidence techniques in which projectile charge-changing events are associated with x-ray emission, target recoil ions, or electron emission. Measurements were conducted using accelerators at the Lawrence Berkeley Laboratory (LBL), Argonne National Laboratory (ANL), Hahn-Meitner-Institut, Berlin (HMI), and Western Michigan University (WMU). The research described here has resulted in 34 published papers, 14 invited presentations at national and international meetings, and 31 contributed presentations. Brief summaries of work completed and work in progress are discussed in this paper.

43421 (FRCEA-TH–273) **Study of quasielastic scattering of electrons on a heavy ion ^{208}Pb. Separation of longitudinal and transverse inclusive cross section.** Zghiche, A. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie; Paris-11 Univ., 91 - Orsay (France). Oct 1989. 201p. (In French). Order Number DE90512025. Source: NTIS (US Sales Only), PC A10/MF A01.

This thesis presents the results of the deep inelastic scattering cross section study on ^{208}Pb. The measurement of these cross sections has been performed from 140 MeV to 645 MeV incident energy for these five values of the scattering angle: 35, 60, 75, 90 and 143 degrees. We have performed the separation of the measured cross section in one longitudinal and one transverse structure functions with the Rosenbluth Diagram method after performing radiative corrections and corrections from the coulomb distortion effects, between 300 and 650 MeV/c for the effective momentum transfer and up to 350 MeV for the energy transfer. The transverse response function shows a disagreement with the independent particle models predictions. The contribution of the exchange currents and the pion electroproduction processes have not been estimated for ^{208}Pb, but will make an explanation for the observed disagreement. The longitudinal response function disagrees also with classical models predictions. The explanation of the longitudinal response reduction in terms of nucleon-nucleon correlations is not satisfying since the strength is only pushed towards higher values of the energy transfer, and the resulting coulomb sum rule (integration over the quasi-elastic peak) still overestimating the experimental values. The particle-hole correlations in the Random Phase Approximation framework, do not improve the disagreement with the experiment. While the modification of the nucleon properties in the nuclear medium would be one better explanation of the result of our experiment.

43422 (HMI-B–469) **The determination of electron momentum densities by inelastic scattering gamma-ray-electron coincidence measurements: The (γ,eγ)-experiment.** Rollason, A.J.; Bell, F.; Schneider, J.R. Hahn-Meitner-Institut Berlin GmbH (Germany, F.R.). Sep 1989. 46p. Order Number DE90512916. Source: NTIS (US Sales Only), PC A03/MF A01.

Measurements have been made of the recoiling electron in 320 keV gamma ray inelastic scattering collisions in thin aluminium targets. The angular correlation of these electrons detected in coincidence with the scattered photon is in agreement with the kinematic requirements of the Compton effect and is correctly predicted by Monte Carlo simulations based on the impulse approximation. Further simulations of ideal-geometry experiments indicate that information about the initial electron momenta is available from an examination of those electron-photon events originating in a surface layer of one electronic mean free path depth and that elastic scattering of the recoil electrons from greater depths produces a nearly flat background to this signal. The results clearly demonstrate the feasibility of the (γ,eγ) experiment for studying electron momentum densities with synchrotron radiation. (orig.) With 23 refs., 17 figs.

43423 (INP–1351/PS) **Raman study of molecular motions in relation to phase transitions in $[Ni(NH_3)_6](NO_3)_2$.** Janik, J.M. (Uniwersytet Jagiellonski, Cracow (Poland). Inst. Chemii); Janik, J.A.; Pick, R.M.; Le Postollec, M. Institute of Nuclear Physics, Cracow (Poland). 1987. 12p. Order Number DE90634522. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A Raman band at 710 cm^{-1} has been used for the study of the NO_3^- ions reorientation and of the phase transitions in $[Ni(NH_3)_6](NO_3)_2$. The strong temperature dependence of the width of this band in phase 1 gives evidence for the NO_3^- reorientations in this phase. The reorientations stop in phase 2. The same band was used for studying the phase 2/phase 3 transition. The large thermal hysteresis of this transition has ben confirmed. 16 refs., 4 figs. (author).

43424 (INP–1395/PS) **Dielectric relaxation and quasielastic neutron scattering study of molecular reorientations in nematic and solid phases of 4, 4' -di-n-butyloxyazoxybenzene (BOAOB).** Chledowska, K. (Politechnika Rzeszowska, Rzeszow (Poland)); Chrusciel, D.; Janik, J.A. Institute of Nuclear Physics, Cracow (Poland). 1988. 30p. Order Number DE90634523. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Dielectric relaxation measurements carried out in nematic BOAOB reveal fast reorientational motions of the whole molecule around the long axis ($\tau_1 \approx 60$ ps) as well as slow reorientational motions of the whole molecule around the short axis ($\tau_1 \approx 10^{-8}$ s). Incoherent quasielastic neutron scattering spectra obtained for nematic BOAOB, with normal and deuterated alkoxy terminals, are inpterpreted as dominated by reorientations (around the C-N bonds) of moieties consisting of benzene rings coupled with alkoxy terminals ($\tau_1 \approx 4$ ps). In addition fast conformational changes occur in the terminals. Dielectric relaxation measurements reveal librations of the whole molecule in phases Cr 1 and Cr 2 accompanied by reorientation of the terminal groups in these phases. The reorientations occur in the time scale amounting to 10^{-8} s. Incoherent quasielastic neutron scattering spectra obtained for Cr 1 and Cr 2 phases of BOAOB were interpreted as dominated by overdamped librational motions of the moieties accompanied by fast conformational changes in the terminals. Cr 3 phase corresponds to a normal molecular crystal. 22 refs., 8 figs., 4 tabs. (author).

43425 (JINR-R–4-89-384) **Generalized oscillator strengths and cross sections of asymmetrical He(e,2e)He^+ reaction in different structure models of the helium atom.** Amirkhanov, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Lkhagva, O.; Moskalenko, I.V.; Khehnmehdehkh, L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 15p. (In Russian). Order Number DE90634524. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Submitted to Vestn. Mosk. Univ.

In this paper the problem of sensitivity has been considered of the triple differential generalized oscillator strengths (TDGOS) and triple differential cross sections (TDS) for electron impact ionization of a helium atom to different structure models of the atom in both initial and final states. In calculations of the TDGOS and TDS in the first Born approximation besides of different functions for a helium atom initial states and also several kinds of distorted waves for ejected electron description in the final state were used. The comparison was made of the received results with recent accurate experimental data and previous theoretical calculations. Good agreement was obtained. 32 refs.; 7 figs.; 1 tab.

43426 (LYCEN-T–87-69) **Charge exchanges and excited states in amorphous or crystalline thin foils of light atomic ions (80-600 KeV/u), of hydrogen aggregates (30-120 KeV/u) and of channeled Xe ions (25 MeV/u).** Farizon Mazuy, B. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Oct 1987. 103p. (In French). Order Number DE90511916. Source: NTIS (US Sales Only), PC A06/MF A01.

Our study concerns electron loss processes and electron capture, radiative or not, in varying experimental situations. First, we have studied interaction of fast hydrogen clusters with solid targets. We report on measurements of angular charge state distributions of hydrogen fragments resulting from the dissociation of fast $H^+ {}^-n$ clusters ($n \leq 21$) in a carbon foil. The proximity effects on the fragment neutralization have been investigated for beam velocities above and around the Bohr velocity. At a given velocity the angular width and the yield of neutral atoms are observed to saturate at $n \geq 5$ and $n \geq 7$, respectively. The interpretation of this behaviour provides some insight into the collective aspects of the collisions and into the structure of hydrogen clusters. A second experimental study lies in confirming the possibility for loosely bound systems such as He^+ to survive the traversal of a thin solid target. The velocity dependences of the population of 2p and 4p states in fast (0.4-2 MeV) He^+ ion beams transmitted through a thin carbon foil have been measured. They are found to be quite different to each other. These results are analyzed in the framework of a simple model based on the possibility for a given excited state to be formed inside the solid. The conclusion is that in the studied velocity range the 2p state can exist in carbon whereas the 4p state cannot. In a third part, we present experimental results showing that channeling measurements with fast stripped heavy ions incident on thin crystals can allow a detailed study of radiative electron capture. We used 25 MeV/u X_e^{53+} ions delivered at Grand Accelerateur d'Ions Lourds (GANIL) in the LISE beam line.

43427 (PNL-SA–18437) **Fundamentals workshop: injecting large ions into the FTICR, and related matters.** Rockwood, A.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-9006241–4: 38. ASMS conference on mass spectrometry and allied topics, Tucson, AZ (USA), 4-8 Jun 1990). Order Number DE90015548. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The fundamentals workshop this year addressed the problem of injection of large ions from external ion sources into the FTICR and the related question of why resolution is unexpectedly low for certain classes of injected ions.

43428 (SAND–90-1957C) **Geometry and B(1s) core excitons of ortho-carborane.** Green, T.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900870–2: 10. international symposium on boron, borides and related compounds, Albuquerque, NM (USA), 27-30 Aug 1990). Order Number DE90014563. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The optimized C_{2v} geometry of ortho-carborane, 1,2-$C_2B_{10}H_{12}$, is determined from Hartree-Fock calculations. For this geometry, a carbon atom is substituted for a boron atom at one of the 4 inequivalent boron sites and the ground-state unrestricted Hartree-Fock eigenvalues and molecular orbitals are found. One thus obtains the valence structure of the B(1s) core-excited molecule according to the Z + 1 approximation. The eigenvalue of the highest occupied molecular orbital is then subtracted from the experimental B(1s) ionization energy of the same site in ortho-carborane. This determines the excitation energy of the most tightly bound exciton for that site. Three of the sites yield nearly identical excitation energies of 191.9 eV; the fourth site yields an excitation energy of 190.9 eV. 8 refs., 1 fig., 2 tabs.

43429 Hyperfine spectral studies of f-transition elements by diode laser-assisted resonance ionization mass spectrometry. Young, J.P. (Oak Ridge National Lab., TN (USA)); Shaw, R.W.; Smith, D.H. pp. 22, Paper NUCL 72 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Semiconductor diode lasers have been used to promote bound-bound transitions that are one step of a multiple photon process used for resonance ionization mass spectrometry (RIMS). It was found that the hyperfine structure of such a transition can be measured if a diode laser is wavelength tuned across the energy of that step in the RIMS process. The ability to obtain such high resolution spectra is believed to be a result of the ion extraction geometry of their experimental configuration. This concept has been demonstrated with lanthanum in a study of the $^2D_{3/2}$ or $^2D_{5/2}$-$^4F^0_{3/2}$ transition. Both lanthanum-139 and -138 have been studied, and the first measurements of the atomic hyperfine structure constants of the $^4F^0_{3/2}$ level at 13,260 cm^{-1} have been made. The experimental details of this study, along with new experimental results for other f-transition elements will be given.

43430 Sum-frequency generation on dye-coated surfaces using collinear and noncollinear excitation geometries. Muenschausen, R.E. (Chemical and Laser Sciences Div., Los Alamos, NM (US)); Nguyen, D.C.; Keller, R.A.; Nogar, N.S. pp. 127-135 of Laser induced damage in optical materials. 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Resonantly enhanced surface second- harmonic generation and sum-frequency generation has been demonstrated on rhodamine 6G coated glass substrates using different excitation geometries. The collinearly excited, doubly-resonant sum-frequency signal is enhanced by more than two orders of magnitude relative to resonantly enhanced second-harmonic generation. For noncollinear excitation, the relative efficiency of nonlinear generation as a function of the angular dependence of the input beams is calculated and compared with experiment.

6404 Fluid Physics

Refer also to citation(s) 42832, 43605

43431 (UCRL-ID–103169) **Lecture notes on incompressible flow and the finite element method.** Gresho, P.M.; Chan, S.T. Lawrence Livermore National Lab., CA (USA). [1989]. 456p. Sponsored by U.S. DOE Energy Research. DOE Contract W-74C5-ENG-48. Order Number DE90014665. Source: NTIS, PC A20/MF A01 - OSTI; GPO Dep.

This report discusses: scalar transport equations; incompressible flow equations; flows with coupled transport equations; and the FEM3 model.

6450 High Energy Physics

43432 (DOE/ER/40085–21) **High energy physics at Tufts University: Progress report, July 16, 1989–July 15, 1990.** Milburn, R.H. Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy. 15 Jul 1990. 109p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-83ER40085. Order Number DE90014664. Source: NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This paper discusses: Soudan II nucleon decay project; neutrino studies; pion and kaon production of charm and charm-strange states; study of heavy flavors at the tagged particle spectrometer; physics at the antiproton-proton collider at $\sqrt{(s)} = 1.8$ TeV; planning for physics at the supercollider; computing and networking; and communications-experimental.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 43214, 43362, 43473, 43479

43433 (FNAL/C–90/104-T) **Three-family top quark mass spectrum.** Albright, C.H. (Fermi National Accelerator Lab., Batavia, IL (USA)). Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900822–5: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE90014985. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We expand upon our previous Monte-Carlo-type study of 3-family mass matrices which lead to the experimentally-determined KM matrix and satisfy the constraints imposed by B_c–$\bar{B}_d$ mixing, $|V_{ub}/V_{cb}|$, B_K and CP violation. Scatter distributions in $|V_{ub}V_{cb}|$, ϵ'/ϵ and x_s vs m_t are presented for the standard minimal Higgs structure as well as top quark mass histograms for the minimal and 2-doublet Higgs models. A top quark mass in the range of 100–200 GeV is strongly favored with all the constraints imposed, but if the lower bound on the CP-violating J-value is completely relaxed, a secondary probability peaking occurs in the mass histograms which lies above 220 GeV in the minimal Higgs model. 19 refs., 5 figs.

43434 (INP–1366/PH) **Hard jet production in cosmic ray particle interactions at the energy of about 1000 TeV.** Buja, Z.; Gladysz, E.; Mikocki, S.; Szarska, M.; Zawiejski, L. Institute of Nuclear Physics, Cracow (Poland). 1987. 45p. Order Number DE90634990. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Eight photon-hadron families with the energy of primary particles of about 1000 TeV detected in a X-ray emulsion chamber of Pamir Experiment have features which indicate the production of hard jets. Lateral distribution and the distribution of transverse momentum flow indicate the existence of two groups of particles. The average transverse momentum for particles in one group is more than 6 times larger then that for the other group. Azimuthal asymmetry is visible in the particle number and transverse momentum flow. Transverse energy E_T for individual families oscillates between 26 and 120 GeV with an average value of 57 GeV. The experimental results were compared with Monte Carlo simulation in which QCD parton hard scattering mechanism in interactions of primary hadrons was assumed. An agreement can be reached if the fraction of jet production exceeded 60% and the transverse momenta of jets are not smaller than 40 GeV/c. 37 refs., 11 figs. (author).

43435 (INP–1398/PH) **Hadronisation of partons in muon-nucleon interactions at 280 GeV/c.** Figiel, J. Institute of Nuclear Physics, Cracow (Poland). 1988. 104p. (In Polish). Order Number DE90634974. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The analysis of the hadronisation process in the deep-inelastic μ^+p and μ^+d interactions at 280 GeV/c is presented. The charge properties of the hadronic final state and their relation to the nucleon structure and fragmentation mechanism are investigated. The observed various forms of correlations between final hadrons are interpreted in terms of the local ordering in the hadronisation process. 42 refs., 39 figs. (author).

43436 (INP–1432/PH) **Intermittency in super-high energy cosmic ray events.** Gladysz-Dziadus, E. Institute of Nuclear Physics, Cracow (Poland). Dec 1988. 21p. Order Number DE90634973. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The factorial moments method described by Bialas and Peschanski was used for investigations of fluctuations in pseudorapidity distributions of nine cosmic-ray events at energy of about 1000 TeV. Both electromagnetic and hadronic components of these events reveal very strong intermittent behaviour. 8 refs., 7 figs., 2 tabs. (author).

43437 (IPNO-DRE–89-17) **Status of the dibaryon structure studies.** Willis, N.; Comets, M.P.; Le Bornec, Y.; Loireleux, E.; Tatischeff, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 12p. (In French). (CONF-8905282–: 5. Saturne meeting, Piriac (France), 16-20 May 1989). Order Number DE90512028. Source: NTIS (US Sales Only), PC A03/MF A01.

The results of recently performed experiments on the B=2 structures concerning the 0,1 and 2 isospin different states are presented. Experimental data and theoretical models are considered. In the T=1 channel, the existence of narrow states, above the πNN threshold, is established. The results from T=0.2 channels are quite difficult to analyse. Present calculations do not allow the prediction of which of the observables are affected by such structures.

43438 (LA-UR–90-2433) **J/ψ and ψ' production with 800 GeV protons.** Moss, J.M. E772 Collaboration. Los Alamos National Lab., NM (USA). [1990]. 9p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-900570–1: 8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90, Menton (France), 7-11 May 1990). Order Number DE90014904. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The yields of J/ψ and ψ' vector meson states have been measured for 800 GeV protons incident on deuterium, carbon, calcium, iron and tungsten targets. A depletion of the yield per nucleon from heavy nuclei is observed for both J/ψ and ψ' production. This depletion exhibits a strong dependence on x_F and p_t. 24 refs., 3 figs.

43439 (LA-UR–90-2530) **A search for $K^+ \to \pi^+\nu\bar{\nu}$ and other rare K^+ decays.** Atiya, M.S. (Brookhaven National Lab., Upton, NY (USA)); Chiang, I.H.; Frank, J.S.; Haggerty, J.S.; Ito, M.M.; Kycia, T.F.; Li, K.K.; Littenberg, L.S.; Stevens, A.J.; Strand, R.C.; Louis, W.C.; Akerib, D.S.; Marlow, D.R.; Meyers, P.D.; Selen, M.A.; ShoemakLos Alamos National Lab., NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900601–2: 12. international conference on particles and nuclei, Cambridge, MA (USA), 24-29 Jun 1990). Order Number DE90014695. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Experiment 787 at Brookhaven, a collaboration of groups from Brookhaven, Los Alamos, Princeton, and TRIUMF, is designed to search for rare K^+ decays, including $K^+ \to \pi^+\nu\bar{\nu}$, $K^+ \to \pi^+\mu^+\mu^-$, and $K^+ \to \pi^+\gamma\gamma$. The experiment uses a low-energy, 775-MeV K^+ beam from the Low Energy Separated Beam at the Alternating Gradient Synchrotron. The typical kaon intensity entering the detector is $\sim 8 \times 10^5$ kaons per 1.8-second spill. 10 refs., 2 figs., 1 tab.

43440 (SLAC-PUB–5240) **Review of results from the Mark 2 experiment at SLC.** Coupal, D.P. Mark II Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-81ER40050 ;AC02-86ER40253 ;AC03-83ER40103 ;AC (CONF-900193–5: Division of particle, Houston, TX (USA), 2 Jan 1990). Order Number DE90014807. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper reviews results on Z^0 physics from the 1989 run of the Mark 2 experiment at the SLAC Linear Collider. Based on about 20 nb^{-1} we present results on the mass, width and branching ratios of the Z^0 boson, the number of light neutrino species, properties of hadronic decays and searches for new particles. 16 refs., 9 figs.

43441 (SSC–143) **Hadron production in hadron-nucleus and nucleus-nucleus collisions in the dual Monte Carlo multi-chain fragmentation model.** Ranft, J. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Sep 1987. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. Order Number DE90014688. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Hadron production in hadron-nucleus and nucleus-nucleus collisions is studied by a Monte-Carlo version of the dual multi-chain fragmentation model. The model takes into account leading order corrections due to the secondary interactions of low energy secondaries inside the target nucleus. An empirical formation time parameter is introduced and used to decide which secondaries interact again inside the target. Data for the multiparticle production in proton-nucleus and oxygen-nucleus interactions at 200 GeV/nucleon from different experiments are well described by the model and consistent with a formation time parameter of $\tau c = 2 \pm 1$ fm. 20 refs., 13 figs.

43442 (UCRL-JC-103454) **High-luminosity, electron-positron colliders as strangeness, charm, and beauty factories.** Barletta, W.A. (California Univ., Los Angeles, CA (USA). Dept. of Physics). Lawrence Livermore National Lab., CA (USA). 29 Mar 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900193-4: Division of particle, Houston, TX (USA), 2 Jan 1990). Order Number DE90015151. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

High luminosity electron-positron colliders operating at the mass of the ϕ meson (1.02 GeV) can produce copious $K\bar{K}^{o}$ pairs from a single quantum state. Temporal correlations in the decays of the K's provide a measure of the direct CP violating amplitude and also allow a high precision of CPT invariance. A low energy collider with high luminosity can serve as a beam physics testbed to evaluate novel approaches to collider design that may be necessary for B factories to attain luminosities $\geq 10^{34}$ $cm^{-2}s^{-1}$. 12 refs., 2 tabs.

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 43459

43443 (BONN-IR-90-08) **W-matrix representation of the off-shell amplitudes for the Bonn potential.** Kuhl, C.B. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Feb 1990. 175p. (In German). Order Number DE90512911. Source: NTIS (US Sales Only), PC A08/MF A01.

Solving the two-body problem the W-matrix mathod is constructed to yield optimal separable two-body input for few-body calculations. This dipl. thesis provides a generalization of the W-matrix approach to the relativistic two-body problem using a realistic (i.e. nonlocal, spin and energy dependent, relativistic) nucleon-nucleon potential. A representation of the two-body off-shell T-matrix by a separable term is shown in which all the physically relevant information is contained and a real, nonsingular, and half on-shell vanishing remainder. (orig.).

43444 (BONN-IR-90-11) **Study of topological properties of point-shaped photon interactions by means of energy flows in hadronic final states at large transverse momenta.** Gapp, C. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Mar 1990. 98p. (In German). Order Number DE90513085. Source: NTIS (US Sales Only), PC A05/MF A01.

The pointlike γ-parton interactions in γ-proton reactions are evaluated in terms of energy-flows. Only charged particles in the forward hemisphere of the overall CM-system (i.e. $\chi_F >> 0$) are used. The pointlike processes should exhibit '2-jetlike' structures. To disentangle the pointlike component from hadronlike photon interactions hadron and photon induced interactions have been studied. The experiment was carried out by the WA69 collaboration using the facilities of the CERN-Ω spectrometer. Both datasets were recorded with identical detector setups in order to minimize systematic effects. A tagged photon beam with energies between 65 and 175 GeV and mixed hadron beams (π^+/K^+, π^-/K^-) at fixed energies of 80 and 140 GeV were used. For high transverse momenta the pointlike interactions are calculable in QCD at lowest order ($\alpha.\alpha_s$). Since energy-flows depend on all final state particles a collective measure for the hardness of an event has been introduced ($\Sigma ip^2_{\text{perpendicular to in eventplane}}$). Only the energy-flows from photoproduction give evidence for the presence of 2-jetlike processes. The hadron induced distributions are scaled in order to emulate the behaviour of a hadronlike photon. The difference between the photon and scaled hadroninduced distributions is compared to a Monte Carlo calculation of the pointlike processes. (orig.).

43445 (CBPF-NF-005/88) **Neutrinos in antipodal universes: parity transformations and asymmetries.** Sasse, F.D.; Soares, I.D.; Tiomno, J. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 15p. Order Number DE90634906. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The members of the class of rotating universes considered in the preceding paper and their antipodals, obtained by an inversion of the vorticity of the matter, are indistinguishable by gravitational observations. It is shown that massless neutrinos produced by weak interaction processes can be used as a probe to distinguish physically such antipodal universes. This is so because the transformation of a universe into its antipodal is not a symmetry of the system universe-plus-neutrinos of a given helicity. (author).

43446 (CBPF-NF-020/86) **New feature for an old large number.** Novello, M.; Oliveira, L.R.A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1986. 8p. Order Number DE90634962. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A new context for the appearance of the Eddington number (10^{39}), which is due to the examination of elastic scattering of scalar particles ($\Pi K \rightarrow \Pi K$) non-minimally coupled to gravity, is presented. (author).

43447 (CBPF-NF-036/89) **On new particles: possible leptons with spin 3/2.** Lopes, J.L. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 32p. (In Portuguese). Order Number DE90634963. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An analysis of experimental consequences is done when the existence of excited leptons with spin 3/2 is supposed, reinvestigating the theoretical calculations. (M.C.K.).

43448 (GSI-90-22(prepr.)) **A new approach to experiments with non-relativistic antiprotons.** Poth, H. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 20p. (CONF-900321--: Physics with high-intensity hadron accelerators, Tokyo (Japan), 14-16 Mar 1990). Order Number DE90512899. Source: NTIS (US Sales Only), PC A03/MF A01.

Is low-energy antiproton physics phasing out with the present round of experiments or are there good reasons to continue at an improved slow antiproton facility which could be located at a high intensity hadron accelerator? We point out, that there are four frontiers where substantial advances could be made. In particular, we discuss the low-energy frontier and emphasize that experiments with no-relativistic antiprotons would increase drastically the sensitivity and would reveal new effects. (orig.).

43449 (INP-1387/PH) **Particle production in ultrarelativistic proton-proton and proton-nucleus collisions in a parton-string model.** Kutschera, M. Institute of Nuclear Physics, Cracow (Poland). 1988. 13p. (CONF-8711345--: The hadron structure '87, Smolenice (Czechoslovakia), 16 Nov 1987). Order Number DE90634940. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The longitudinal momentum distributions of particles produced in proton-proton and proton-nucleus collisions are calculated in terms of quark distribution functions and empirical string fragmentation functions. With very few parameters I consistently describe the projectile fragmentation region in hadron-nucleus collisions at 100 GeV. 9 refs., 4 figs. (author).

43450 (INP-1394/PH) **The two gluon exchange model for $\gamma\gamma$ interactions at high energies.** Suwara, M. Institute of Nuclear Physics, Cracow (Poland). 1988. 52p. Order Number DE90634924. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The model of $\gamma\gamma$ pointlike interactions via the two gluon exchange is presented. The model is developed using the Sudakov techniques for the high energy limit. Its predictions for the experimentally measured quantities of $\sigma_{\text{inclusive}}^{\text{tot}}$ and the structure function $F_2(x,Q^2)$ are found in a good agreement with the predictions of GVDM model. Used together with the QPM it can explain the experimental data for the whole kinematical region available in the recent experiments. 19 refs., 12 figs. (author).

43451 (INP-1427/PH) **Unified description of nuclear shadowing of virtual photons.** Kwiecinski, J. (Institute of Nuclear Physics, Cracow (Poland)); Badelek, B. Institute of Nuclear Physics, Cracow (Poland). 1988. 13p. (CONF-8806260--: 19. international symposium on multiparticle dynamics - new data and theoretical trends, Arles (France), 13-17 Jun 1988). Order Number DE90634925. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The nuclear structure function is analysed in the shadowing region for small and moderately large values of Q^2. Both the vector meson rescattering and the partonic contribution to shadowing are considered. The theoretical results are compared with the experimental data. 13 refs., 2 figs. (author).

43452 (IPNO-TH–89-32) **Skyrmions model and related topics.** Le Tourneux, J. (Montreal Univ., PQ (CA). Lab. de Physique Nucleaire). Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Jun 1989. 41p. (In French). (CONF-8809492–: French 3. Cycle interuniversity wokshop on Nuclear Physics, Esneux (France), 14-16 Sep 1988). Order Number DE90512032. Source: NTIS (US Sales Only), PC A03/MF A01.

Lectures on the Skyrme model are presented. The aim of the work is, by studying some basic concepts, to allow an easier understanding of the model and its applications, for nuclear physicists. The skyrmion model provides a link between QCD and hadrons (and its interactions). The analysis of $N_C \rightarrow \infty$ and the topological soliton concept is carried out. The chiral symmetry main aspects, the nonlinear σ model and its properties are examined.

43453 (JINR–7-33-88, pp. 32-37) **Calculation of spin-flip amplitude of charge-exchange process $\pi^-p \rightarrow \pi^0 n$.** Goloskokov, S.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Selyugin, O.V.; Teplyakov, V.G. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications: Collection*. Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

It is shown that the spin-flip amplitude of the charge-exchange $\pi^-p \rightarrow \pi^0 n$ reaction calculated in the dynamical model of hadron interactions correctly reproduces basic features of the spin-flip amplitude determined by the amplitude analysis of experimental data at P_L=40 GeV. 10 refs.; 2 figs.

43454 (LA-UR–90-2462) **Baryon and lepton number violation in the electroweak theory at TeV energies.** Mottola, E. Los Alamos National Lab., NM (USA). [1990]. 19p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-7405-ENG-36. (CONF-9004225–2: Conference on baryon number violation at the SSC, Santa Fe, NM (USA), 27-30 Apr 1990). Order Number DE90014900. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In the standard Weinberg-Salam electroweak theory baryon and lepton number (B and L) are NOT exactly conserved. The nonconservation of B and L can be traced to the existence of parity violation in the electroweak theory, together with the chiral current anomaly. This subtle effect gives negligibly small amplitudes for B and L violation at energies and temperatures significantly smaller than $M_W \sin^2 \theta_W/\alpha \sim 10$ TeV. However, recent theoretical work shows that the rate for B and L nonconservation is unsuppressed at higher energies. The consequences of this for cosmology and the baryon asymmetry of the universe, as well as the prospects for direct verification at the SSC are discussed. 13 refs., 3 figs.

43455 (NBI-HE–90-18) **Lattice simulations of electroweak sphaleron transitions in real time.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)); Askgaard, T.; Porter, H.; Shaposhnikov, M.E. Niels Bohr Inst., Copenhagen (Denmark). Apr 1990. 24p. Order Number DE90634907. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We perform a numerical investigation of high temperature transitions involving the change of topological charge in the electroweak theory. 3-dimensional space is approximated by a lattice. The dynamics is followed in real time, not Euclidian time. Transitions were observed in the phase with spontaneus symmetry breaking as well as in the phase with restored symmetry. We determine the rate Γ of fermion number non-conservation in electroweak theory in the phase with restored symmetry. There is no suppression and $\Gamma = \kappa(\alpha_W T)^4$ with $\kappa \simeq 0.1\text{-}1.0$. (orig.).

43456 (RAL–90-018) **The gluon distribution at small x - a phenomenological analysis.** Harriman, P.N. (Durham Univ. (UK). Dept. of Physics); Martin, A.D.; Stirling, W.J.; Roberts, R.G. Rutherford Appleton Lab., Chilton (UK). Mar 1990. 12p. (DTP–90-12). Order Number DE90634941. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The size of the gluon distribution at small χ has important implications for phenomenology at future high energy hadron-hadron and lepton-hadron colliders. We extend a recent global parton distribution fit to investigate the constraints on the gluon from deep inelastic and prompt photon data. In particular, we estimate a band of allowed gluon distributions with qualitatively small-χ behaviour and study the implications of these on a variety of cross sections at high energy pp and ep colliders. (author).

43457 (WU-B–89-1) **Analysis of low energy antiproton-proton forward scattering.** Kroll, P. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 8 - Naturwissenschaften 1 - Physik); Schweiger, W. Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Jan 1989. 30p. Source: Also published in Nucl. Phys., A (30 Oct 1989) v. 503(3/4) p. 865-884.

Based on previous analyses of forward anti pp and pp scattering within the dispersion theoretical approach we have investigated anti pp scattering making use of new experimental information from LEAR and the CERN anti pp collider. The main interest is focused on the low energy region although the high energy region is also discussed briefly. We present a rather natural explanation of the peculiar features of the LEAR data on the ρ parameter. Moreover, we address ourselves to the problems of Coulomb contamination of the data, the normalizations and the extraction of the anti pp scattering length from line shifts and widths of the anti pp atom. These effects are estimated using a simple optical model appropriately designed for the low energy region. (orig.).

6453 Particle Invariance Principles and Symmetries

43458 (CBPF-NF–023/89) **Quantization of self-dual field revisited.** Srivastava, P.P. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 9p. Order Number DE90634501. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Self-dual field is described by the Lagrangian for ordinary scalar field with a term added to it to take care of the self-duality constraint. A self-consistent Hamiltonian formulation is obtained using Dirac's method. The constraints are second class, the auxiliary field drops out of the Hamiltonian and the quantized theory does not show any violation of causality. (author).

43459 (LAL–8940) **Status in CP violation.** Fayard, L. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Nov 1989. 15p. (CONF-8908240–: Workshop on new phenomenology in high energy physics and cosmology, TRIESTE (Italy), 16-17 Aug 1989). Order Number DE90511908. Source: NTIS (US Sales Only), PC A03/MF A01.

Twenty-five years after the discovery of CP violation in the neutral Kaon system, we still dont know exactly the origin and the components of that weak non invariance. The two more precise experiments give slightly different answers concerning the direct way of CP violation NA 31 gives ϵ prime/ϵ incompatible with the Superweak Model (for which ϵ prime=0) and in agreement with Standard Model predictions compatible with both. Again, one needs new and precise results in order to conclude about ϵ prime. E731 and NA31 are actually working on their new data samples. Longer term ideas are also being discussed, looking for new experiments able to give ϵ prime/ϵ with a precision. Concerning CPT invariance the situation seems to be more clear.

43460 (UFPB-DF–01/89/A) **Gauge invariance and Nielsen identities.** Lima, A.F. de; Bazaia, D. Paraiba Univ., Joao Pessoa, PB (Brazil). Dept. de Fisica. 1989. 17p. Source: Available from Centro de Informacoes Nucleares of the Comissao Nacional de Energia Nuclear, RJ, Brazil.

The one-loop contribution to the effective potential and mass are computed within the context of scalar electrodynamics for the class of general R gauges in the MS scheme. These calculations are performed in order to construct a non-trivial verification of the corresponding Nielsen identities within the context of the Higgs model. Some brief comments on the Coleman-Weinberg model are also included. (author).

6454 Field Theory

43461 (IFUSP-P–765) **Self-dual fields and causality.** Girotti, H.O. (Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Inst. de Fisica); Gomes, M.; Rivelles, V.O.; Silva, A.J. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Jan 1989. 9p. Order Number DE90634433. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Causality aspects of two dimensional self-dual fields are considered. We prove that there is no causal propagation for dimensionless self-dual fields whose Lagrangian does not contain dimensional parameters. It is shown that causal self-dual bosons are possible in the chiral Schwinger model which contains a dimensional charge. (author).

43462 (IFUSP-P–772) **Spinning self-dual particles.** Gamboa, J.; Rivelles, V.O. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Feb 1989. 13p. Order Number DE90634434. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We study spinning self-dual particles in two dimensions. They are obtained from the chiral bosonic particle through the square root technique. We show that the resulting field theory can be either fermionic or bosonic and that the associated self-dual field reveals its Lorentz tensor structure which remains hidden in the usual formulations. We also calculate the spinning self-dual particle propagators using the BFV formalism. (author).

43463 (IFUSP-P–782) **On the phase structure of the compact abelian lattice Higgs model.** Barata, J.C.A. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. May 1989. 19p. Order Number DE90634435. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The vacuum overlap order parameter proposed by Fredenhagen and Marcu is studied in the case of the compact U(1) gauge model with the Wilson action coupled to a Higgs field. The existence of two distinct phases in D space-time dimensions ($D \geq 4$) is established. (author).

43464 (IFUSP-P–788) **Kinetic approach to the initial value problem in quantum field theory.** Lin Chi Yong; Toledo Piza, A.F.R. de. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Jun 1989. 13p. Order Number DE90634436. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Time-dependente projection techniques developed to derive kinetic equations in the context of the quantum many-body problem are applied to ϕ^4 field theory. The approach is illustrated by working out the 0+1 dimensional case explicitly, including numerical solutions of the kinetic equations. Extension to higher dimensions is briefly discussed. (author).

43465 (IFUSP-P–805) **Dirac-bracket quantization of chiral scalar two dimensional QED-II.** Abdalla, M.C.B. (Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil)); Zadra, A.; Abdalla, E. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1989. 13p. Order Number DE90634437. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We quantize, via Dirac procedure, gauge covariant chiral bosons using different Lagrange densities. We discuss ambiguities of the quantization procedure, and propose a 'correct' procedure. A generalization of the Siegel symmetry is obtained. Finnally, using a certain modified Lagrangian. We obtain a theory equivalent to chiral QED in two dimensions. (author).

43466 (LAL–8939) **An introduction about precise measurements of QED γ structure functions.** Courau, A. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Nov 1989. 13p. (CONF-8905213–: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989). Order Number DE90511905. Source: NTIS (US Sales Only), PC A03/MF A01.

Pure QED processes are theoretically exactly computable. However precise measurements and theoretical expectations of QED γ structure functions within a given experimental acceptance are not so trivial. Yet such a study is quite interesting. It supplies on the one hand a good QED test and, on the other hand, a good exercise for testing the procedure used for the determination of the hadronic γ structure functions.

43467 (NBI-HE–90-17) **A comment on the nonperturbative D=1 string theory.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)); Jurkiewicz, J.; Krzywicki, A. Niels Bohr Inst., Copenhagen (Denmark). Apr 1990. 8p. (LPTHE–90/11). Order Number DE90634438. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

We analyze in detail the strong coupling phase of nonperturbative d=1 string theory and show that the scaling limit is non-universal. (orig.).

43468 (NBI-HE–90-20) **Symmetries of Chern-Simons theory in Landau gauge.** Damgaard, P.H. (Niels Bohr Inst., Copenhagen (Denmark)); Rivelles, V.O. Niels Bohr Inst., Copenhagen (Denmark). Apr 1990. 8p. Order Number DE90634439. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

In d=3 dimensions the IOSp(dvertical stroke2) algebra admits a non-trivial modification. We show that 3-dimensional Chern-Simons theory in Landau gauge has a global symmetry based on this large Lie superalgebra. (orig.).

65 PHYSICS II

Refer also to citation(s) 43239

6510 Nuclear Physics

Refer also to citation(s) 43101, 43104, 43105, 43106, 43107, 43108, 43412, 43413, 43414, 43528

43469 (DOE/ER/40531–1) **Nucleus-nucleus collisions and the nuclear equation of state: Progress report, August 15, 1989–May 4, 1990.** Keane, D. Kent State Univ., OH (USA). Dept. of Physics. 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER40531. Order Number DE90015427. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Activities during the past year have been centered around: the analysis of existing experimental data from the Bevalac streamer chamber and from the Kent state neutron flow experiment 848H; transport model comparisons with these data and with published results from other experiments; and development of future Bevalac experiments, with particular emphasis on the EOS TPC. Activities under and above have led to 10 papers either published or submitted for publication in journals or conference proceedings during the 12-month period ending in March 1990. The PI is spokesperson for one of three beam-time proposals for the first round of experiments at the EOS TPC, to be considered by the Bevalac PAC in June 1990. Planned activities for the coming budget period include a continuation of strong emphasis on the TPC, and the initiation of participation in a planned RHIC experiment.

43470 (INDC(NDS)–234) **Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.** Kocherov, N.P. (comp.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. 114p. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The papers presented by the participants during the Research Co-ordination Meeting on Measurement and Analysis of Double Differential Neutron Emission Spectra in (p,n) and (α,n) Reactions are published here. A separate abstract was prepared for each of these 9 papers. Refs, figs and tabs.

43471 (IPNO-DRE–89-16) **Spin-isospin excitations induced by heavy ions at Saturne energies.** Hennino, T. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 11p. (In French). (CONF-8905282–: 5. Saturne meeting, Piriac (France), 16-20 May 1989). Order Number DE90512030. Source: NTIS (US Sales Only), PC A03/MF A01.

Our program on the Spin-Isospin excitations started with the (^{3}He,^{3}H) and (^{2}H,^{2}He) reactions was extended with the heavy ion

beams available at Saturne (^{12}C, ^{16}O, ^{20}Ne and ^{40}Ar) to study systematically the Δ excitation energy region. Projectile-ejectile dependences were measured. The Δ peak shift appears as a common feature in all charge exchange reactions. The first cross section calculations for the (^{12}C,^{12}N) reaction are in good quantitative agreement with the data.

43472 (JAERI-M–90-099) **Curves and tables of neutron cross sections: Japanese Evaluated Nuclear Data Library, version 3.** Nakagawa, Tsuneo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Asami, Tetsuo; Yoshida, Tadashi. Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment. ©Jul 1990. 486p. Sponsored by Japan Atomic Energy Research Institute. (NEANDC(J)–153/U;INDC(JPN)–140/L). Source: Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, 319-11, Japan.

Neutron cross-section curves from the Japanese Evaluated Nuclear Data Library version 3, JENDL-3, are presented in both graphical and tabular form for users in a wide range of application areas in the nuclear energy field. The contents cover cross sections for all the main reactions induced by neutrons with an energy below 20 MeV including; total, elastic scattering, capture, and fission, (n,n′), (n,2n), (n,3n), (n,α), (n,p) reactions. The 2200 m/s cross-section values, resonance integrals, and Maxwellian- and fission-spectrum averaged cross sections are also tabulated.

43473 (JINR–7-33-88, pp. 38-46) **A dependence of cumulative pion production cross sections in proton-nuclear interactions at high energies.** Belyaev, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki); Gavrishchuk, O.P.; Zolin, L.S.; Peresedov, V.F. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The A dependence of cumulative pion production yield cross sections on the basis of the comparison of the data on relative pion yields on Be,C,Al,Ti,Mo and W nuclei at the 159 deg angle laboratory system for the incident proton energy E_0 from 25 to 62 GeV is considered. The regular A dependence on cumulative variable X is noted. The results are compared with the data at $E_0 < 10$ GeV. A possible interpretation of the observed behaviour on the basis of the hypothesis of the flucton mechanism of the pion production in the cumulative region is discussed. 15 refs.; 4 figs.

6511 Experimental Techniques

Refer also to citation(s) 43103, 43110

43474 (LA-UR–90-2594) **Closing comments on the workshop on short-lived nuclear beams.** Garvey, G.T. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9004209–5: Workshop on the science of intense radioactive ion beams, Los Alamos, NM (USA), 10-12 Apr 1990). Order Number DE90014976. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Short communication. ION BEAMS/production; PRODUCTION; BINDING ENERGY; ORBITS; MATRIX ELEMENTS; RADIOISOTOPES; EQUATIONS OF STATE; NUCLEAR DEFORMATION; HELIUM 10; HELIUM 4

43475 RIS [Resonance Ionization Spectroscopy] applications to particle physics. Hurst, G.S. (Atom Sciences, Inc., Oak Ridge, TN (USA)). pp. 16, Paper NUCL 51 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

Resonance Ionization Spectroscopy, RIS, is a process in which valence electrons can be removed from a laser wavelength selected atom with nearly unit efficiency. The selectivity-sensitivity of RIS is an important joint property, making possible a range of new analytical capabilities. Thus, RIS has been combined with mass spectrometers for the Z-selective and A-selective counting of individual noble gas atoms or atoms ejected from solids by ion or laser sputtering. This presentation will concentrate on the noble gas analysis and describe the capability at Atom Sciences for counting Kr atoms with isotopic selectivity. An update will be given on the feasibility of a proposed solar neutrino experiment, in which ^{81}Kr is produced by interaction with ^{81}Br. Double beta-decay can product ^{82}Kr from the decay of ^{82}Se, and this experiment may also be feasible. Finally, ^{81}Kr is useful for dating old groundwater, since the half-life is 200,000 years.

43476 The US AVLIS [Atomic Vapor Laser Isotope Separation] enrichment program for uranium isotope separation. Eby, R.S. (Lawrence Livermore National Lab., CA (USA)). pp. 20, Paper NUCL 67 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

In 1985, the US Department of Energy chose the Atomic Vapor Laser Isotope Separation (AVLIS) process as its advanced uranium enrichment process for the future. Since that time, the AVLIS program has advanced through various stages of development is now geared toward completing a full-scale integrated enrichment demonstration in 1992, leading to a November 1992 decision to deploy an AVLIS production plant with plant startup as early as 1997. This paper will describe the AVLIS process, discuss demonstration and deployment plans, and highlight recent technical progress. Some major accomplishments include: (1) operating the world's highest average power visible light laser system continuously at over 7,000 watts and accumulating more than 1 million hours copper vapor laser head time; (2) vaporizing metric tons of uranium in a full-scale separator unit; and (3) developing new low-cost and low waste producing methods for integrating the metal-based AVLIS system into the nuclear fuel cycle.

43477 Anti-Stokes luminescence of selected curium compounds. Murray, G.M. (Univ. of Tennessee, Knoxville (USA)); del Cul, G.D.; Begun, G.M.; Young, J.P.; Peterson, J.R. pp. 21, Paper NUCL 69 of American Chemical Society, Division of Nuclear Chemistry and Technology. American Chemical Society, Washington, DC (US) (1990). DOE Contract FG05-88ER13865 ;AC05-84OR21400. (CONF-900402–: 199. national meeting of the American Chemical Society, Boston, MA (USA), 22-27 Apr 1990).

The anti-Stokes luminescence from up to six excited state manifolds of Cm^{3+} ion in several compounds was observed under dye laser excitation at 77 K. The mechanism for the production of the anti-Stokes luminescence will be discussed and the crystal field splittings of the luminescence manifolds will be correlated with crystallographic site symmetry. The very low background produced by this method allows the observation of luminescence from excited states normally obscured by matrix scatter and matrix luminescence.

6512 Nuclear Properties and Reactions, A = 1-5, Experimental

43478 (JINR–7-33-88, pp. 15-22) **Elastic scattering of antiproton on ^{4}He at 600 MeV/c.** Batusov, Yu.A. (and others); Bunyatov, S.A.; Pontekorvo, D.B. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Differential cross sections of p-bar^4 He elastic scattering have been measured at 607.7 MeV/c with a streamer chamber in a magnetic field. Elastic cross section σ_{el}=(119.9±2.5) mb and total cross section σ_{tot}=(359.1±5.6) mb have been obtained. Comparison of measured differential cross sections to Glauber model calculations has been made. 10 refs.; 4 figs.

43479 (JINR–7-33-88, pp. 23-31) **Production of neutral strange particles in p-bar^{4}He annihilation at 600 MeV/c.** Batusov, Yu.A. (and others); Bunyatov, S.A.; Pontekorvo, D.V. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number

DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Cross sections of Λ-hyperons and K_S^0-mesons production in antiproton annihilation in ^{4}He at 600 MeV/c have been measured: $\sigma(\Lambda)=(4.25\pm0.64$ mb and $\sigma(K)=4.51\pm0.60)$mb. The Λ/K_S^0 yield ratio was found to be $R=\sigma(\Lambda)/\sigma(K)=0.94\pm0.19$. Rapidity and momentum spectra of particles are satisfactorily explained by the hypothesis about Λ production in secondary interactions of K-barmesons (which appeared in p-barN-annihilation) inside the nucleus. 9 refs.; 2 tabs.

6513 Nuclear Properties and Reactions, A = 6-19, Experimental

Refer also to citation(s) 43034

43480 (INIS-BR-2129) **Measurement of ^{18}O + ^{10}B fusion cross section and construction of a position sensitive ionization chamber.** Added, N. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1987. 141p. (In Portuguese). Order Number DE90635062. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

The ^{18}O + ^{10}B fusion reaction has been investigated within the bombarding energy range of 29,0 MeV < E_{lab} < 72,0 MeV, covering the $5^0 < \theta_{lab} < 27^0$ angular range. For this purpose, a high resolution position sensitive ionization chamber has been developed and constructed. Experimental results compared to model predictions and experimental systematics found in the literature allows to reject compound nucleus limitation to the fusion cross section up to energies as high as five times the coulomb barrier. Statistical model fits to the residues elementary distributions reveal a quite difuse partial fusion cross section in the angular momentum space. Systematic analysis of fusion barrier height (V_B) and radius (R_B) for neighbouring nuclei point out the importance of the nuclear matter difuseness in the competition between the fusion and quasi-direct process. Calculations within this framework were performed. (author).

43481 (INP-1370/PL, pp. 367-370) **Nuclear spectroscopy of ^{18}F related to stellar nucleosynthesis.** Landre, V. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, 91 - Orsay (France)); Bogaert, G.; Aguer, P.; Lefebvre, A.; Thibaud, J.P.; Fortier, S.; Maison, J.M.; Vernotte, J. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The ^{17}O(p,α)^{14}N and ^{17}O(p,γ)^{18}F reactions involved in the secondary branch of the main CNOcycle of stellar evolution are examined. The spectroscopic factor related to the width is deduced for a 5.668 MeV level from a stripping reaction ^{17}O(3He,d)^{18}F at the Orsay Tandem. 13 refs., 1 fig. (M.F.W.).

43482 (INP-1399/PL) **Reactions in the D + ^{9}Be system and the Ghost Anomaly.** Szczurek, A. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). Inst. Fizyki. 1988. 150p. Order Number DE90635064. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

The aim of the present work is to study in detail the problem of the Ghost Anomaly and the line shape of the first excited state of ^{8}Be. For this purpose a kinematically complete measurement of the reaction ^{9}Be(d,tα)^{4}He has been performed in some geometrical configurations at the energy 7 MeV. The theoretical analysis of the results of the coincidence experiment takes into account both sequential and quasi free processes. The sequential processes have been analysed on the basis of R-matrix theory. Due to the low relative alpha-alpha energy in the region of the Ghost Anomaly and the large width of the 2^+ state of ^{8}Be, the energy dependence of the factors determining a resonant state has been analysed carefully. The possible contribution of quasi-free processes and their influence on the observed spectra has been considered. The knowledge of reaction mechanism leading to the ground and first excited states of ^{8}Be is necessary to perform the above analysis. 179 refs., 42 figs. (author).

43483 (JINR-7-33-88, pp. 5-14) **Properties of four-dimensional baryon clusters in cumulative nucleus-nuclear interactions.** Lyubimov, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Togoo, R. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The four-dimensional proton clusters connected with the fragmentating target-nucleus in pC- and CC interactions accompanying by emission of cumulative pions and protons (P_p=10 GeV/c, P_c/N=4.2 GeV/c) have been analyzed. The work was carried out using the pictures from the 2-meter propane bubble chamber. The connection of the produced cluster properties with cumulative hadron production is considered. The effect of the cumulative pion production process on the properties of these clusters has been found out. 6 refs.; 4 figs.; 7 tabs.

43484 (Juel-2196) **Studies of (n,t) reactions on light nuclei.** Suhaimi, A. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Chemie 1 - Nuklearchemie. Apr 1988. 138p. Order Number DE90513084. Source: NTIS (US Sales Only), PC A07/MF A01.

Cross Sections were measured with uncertainties of 13 to 21% for the reactions ^{9}Be(n,t)^{7}Li, ^{10}B(n,t)2α and ^{14}N(n,t)^{12}C over various energy ranges. Irradiations were performed with thermal neutrons and neutrons produced via the reactions ^{2}H(d,n)^{3}He and ^{9}Be(d,n)^{10}B. The tritium produced and accumulated in the irradiated samples was separated by vacuum extraction and measured in the gas phase using anticoincidence β^- counting. The residual tritium content was determined for the enriched ^{10}B and AlN samples. The characteristics of tritium diffusion in B_4C were studied by high-temperature release experiments. The Li impurity in the AlN sample was determined via neutron activation analysis. The average ^{9}Be(n,t)^{7}Li cross sections lie between 3 and 14 mb for break-up neutrons produced by 17.5 to 31.0 MeV deuterons on a thick Be target. A comparison of the measured data with the values deduced from differential data and neutron spectral distributions shows agreement within ± 21%. The ^{10}B(n,t)2α cross sections in the neutron energy range of 0.025 eV to 10.6 MeV lie between 12 and 215 mb (with the maximum at about 5.5 MeV). The ^{14}N(n,t)^{12}C cross sections in the neutron energy range of 5.0 to 10.6 MeV lie between 11 and 30 mb. The excitation function shows a fluctuation which is attributed to the decay properties of the compound nucleus ^{15}N. Detailed Hauser-Feshbach calculations show that the statistical model cannot satisfactorily describe the (n,t) cross section on light nuclei. (orig.).

6514 Nuclear Properties and Reactions, A = 20-38, Experimental

Refer also to citation(s) 43365

43485 (INP-1370/PL, pp. 183-201) **The mass and radius of nuclei far from stability.** Schutz, Y. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Ganil-Saclay-Lanzhou-Orsay-CEN Collaboration. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Production and identification of nuclei far from stability are discussed and the role of systematic measurement of ground state masses of exotic nuclei is presented. The different methods of mass measurement are reviewed. The applied at GANIL is explained in details and the data obtained so far are discussed. 12 refs., 9 figs. (author).

43486 (INP-1392/PL) **Investigation of the properties of ^{29}Si resonance at 33.1 MeV excitation energy.** Wolski, R.; Skwirczynska, I.; Budzanowski, A.; Freindl, L.; Jakiel, J.; Karcz, W.; Szmider, J. Institute of Nuclear Physics, Cracow (Poland). 1988. 18p. Order Number DE90635067. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The angular distributions for elastic scattering $\alpha + {}^{24}Mg$ were measured at energies corresponding to extrema of the excitation function. The cross sections of the $^{24}Mg(\alpha,{}^{12}C){}^{16}O$ and $^{24}Mg(\alpha,\alpha){}^{24}Mg$ reactions have been used to determine partial widths for resonance at E_{ex} = 33.1 MeV in the ^{28}Si nucleus (27.1 MeV in the lab system for $\alpha + {}^{24}Mg$ channel). 7 refs., 2 figs., 2 tabs. (author).

43487 (INP–1402/PL) **Π^0 - production in heavy ion collisions at energy of beam 38 MeV/U.** Bellini, V. (Catania Univ. (Italy)); Bolore, M.; Chauvin, J. Institute of Nuclear Physics, Cracow (Poland). 1988. 16p. Order Number DE90635068. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Inclusive Π^0 - production in the $^{16}O + Al,Au \geq \Pi^0 + X$ reactions has been studied at Elab/A = 38 MeV. The neutral pions are detected through the decay $\Pi^0 \geq \gamma + \gamma'$ using a Pb-glass Cherenkov - detector spectrometer. The observed large inclusive cross sections are consistent with the results of experiments done using different projectile-target combinations and indicate the presence of large cooperative effects in the Π^0 production mechanism at this energy. The reabsorption effects play important role on pions spectra observed. 17 refs., 6 figs. (author).

6515 Nuclear Properties and Reactions, A = 39-58, Experimental

Refer also to citation(s) 43485

43488 (DOE/ER/40326–17) **Neutron cross section measurements using the Oak Ridge electron linear accelerator: Performance report, August 1989–July 1990.** Winters, R.R. Denison Univ., Granville, OH (USA). Dept. of Physics. Aug 1990. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40326. Order Number DE90015361. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

During this reporting period, the work supported under DOE Grant No. FG02-87ER40326.A003 has resulted in one publication, two papers submitted to Phys. Rev. C for publication, and one paper presented at a professional meeting. During this period, modifications were made to the interactive R-Matrix fitting computer program DSIG to include the total radiation widths in the R-Matrix calculation of the cross section. The R-Matrix analyses of $n+{}^{90}Zr$ and $n+{}^{208}Pn$ have already begun.

43489 (INDC(NDS)–234, pp. 7-17) **Level densities for ^{51}Cr and ^{59}Ni deduced from (p,n) and (α,n) spectra.** Grimes, S.M. (Ohio Univ., Athens, OH (USA)); Pedroni, R.S.; Brient, C.E.; Mishra, V.; Boukharouba, N. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Measurements of the (p,n) spectrum from targets of ^{51}V and ^{59}Co and the (α,n) spectrum from ^{48}Ti and ^{56}Fe targets have been made. Comparison of the measurements with Hauser-Feshbach calculations allowed level density parameters for ^{51}Cr and ^{59}Ni to be deduced. For proton energies up to 8.5 MeV and alpha energies up to 13 MeV, both reactions are dominated by compound nuclear processes. (author). 9 refs, 17 figs.

6516 Nuclear Properties and Reactions, A = 59-89, Experimental

Refer also to citation(s) 43488, 43489, 43495, 43504, 43522

43490 (INP–1370/PL, pp. 389-391) **Fusion reactions in the near barrier region investigated with the $4\pi\gamma$-detector "Chateau de cristal".** Duchene, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

In an attempt to explain the missing cross section observed in different fusion experiments spin distribution measurements with the $4\pi\gamma$ multidetector system and total fusion-evaporation measurements for the $^{16}O + {}^{144}Nd$ and $^{80}Se + {}^{80}Se$ near the barrier region were performed. The fission fragments produced in $^{16}O + {}^{144}Nd$ reaction were detected and the cross sections were measured. 6 refs., 1 tab. (M.F.W.).

43491 (INP–1370/PL, pp. 419-421) **Near-yrast spectroscopy of the N=48 nuclide ^{84}Kr.** Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Doering, J.; Funke, L. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

About twenty new levels in ^{84}Kr up to spin $14\hbar$ and 7.6 MeV excitation energy have been established as a result of an extensive in-beam spectroscopic study via the $^{82}Se(\alpha,2n)$ reaction. 2 refs., 1 fig. (author).

6517 Nuclear Properties and Reactions, A = 90-149, Experimental

Refer also to citation(s) 43488, 43490, 43506, 43536

43492 (CBPF-NF–011/89) **Fission of Al, Ti, Co, Zr, Nb, Ag, In, Nd, Sm, and Ta nuclei induced by 0.8-1.8 GeV photons.** Lima, D.A. de (Paraiba Univ., Joao Pessoa, PB (Brazil). Dept. de Fisica); Martins, J.B.; Tavares, O.A.P. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 20p. Order Number DE90635077. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Samples of Al, Ti, Co, Zr, Nb, Ag, In, Nd, Sm, and Ta elements in contact with solid state nuclear track detectors were exposed to 0.8-1.8 GeV bremsstrahlung beams at the 2.5-GeV Electron Synchrotron of the Bonn University. The detectors were processed to produce visible fission tracks for track analysis with optical microscopes. Absolute mean cross section per photon and fissility were evaluated. Results are discussed and compared with other photofission data as well as with estimates from the current fission models. A broad minimum found for nuclear fissility of 10^{-4}-10^{-3} covering the range 15 approx Z^2/A approx 25 seems to confirm the predictions from the models. For Al and Ti nuclei the probability of fission amounts to approx 10^{-1}. (author).

43493 (INDC(NDS)–234, pp. 19-29) **Report on the IAEA research agreement No. 4412/CF.** Guenther, P.T. (Argonne National Lab., IL (USA). Engineering Physics Div.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The results of double-differential neutron-scattering cross section measurements on the mono-isotopic (or essentially mono-isotopic) elements Nb, Rh, In, Ho, Ta, Au and Bi in the energy range 5-8 MeV and angular range 30-158 degrees are presented. 8 refs, 9 figs.

43494 (INDC(NDS)–234, pp. 57-75) **Double differential cross sections for the (p,n) reactions of 13.1 MeV protons with**

^{94,95,96,97,98,100}Mo. Broeer, T.; Mordhorst, E.; Stamer, S.; Trabandt, M.; Scobel, W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Cross sections for the inclusive production of neutrons of 13.13±0.15 MeV protons with all stable Molybdenum isotopes (with the exception of ^{92}Mo) have been measured with time-of-flight techniques for 22 angles ranging from 3 deg. to 177 deg. After a short presentation of the motivations for this work, the experimental set up and the tables of double differential and angle integrated cross sections are presented. (author). 11 refs, 4 figs, 2 tabs.

43495 (INDC(NDS)–234, pp. 77-89) **Double differential neutron emission cross sections of (p,n) reactions on Co-59 and Mo isotopes.** Zhou Zuying (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Tang Hongqing; Sa Jun; Sui Qingchang; Qi Bujia; Yu Chunying; Shen Guanren. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Neutron emission spectra from (p,n) reactions on Co-59 and Mo-95, Mo-96, Mo-97, Mo-98, Mo-100 in the incident energy range 9-15 MeV were measured by means of TOF technique at the HI-13 tandem Van de Graaff accelerator in the Institute of Atomic Energy, Beijing, China. 3 refs, 14 figs, 2 tabs.

43496 (INP–1355/PL) **Properties of nuclei with proton binding energy close to zero.** Potempa, A. Institute of Nuclear Physics, Cracow (Poland). 1987. 80p. (In Polish). Order Number DE90635081. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

A specific method of the end point energy of β^+ - spectra measurements has been used. The end point energy of β^+ - spectra for 23 isotopes in the rare-earth region has been determined. Using the data of the present work and the data of alpha decay chains, beta decay energies for 35 nuclides and atomic masses for 69 nuclides were evaluated, including nuclides laying far from the beta stability line. The presented results allow an analysis of the applicability of the existing atomic mass formulae. Corrections to these formulae have been proposed. An increase of the pairing energy with increasing atomic number for even isotones with N = 84 - 94 has been found. In beta decay of Gamow-Teller type a renormalization of the axial-vector coupling costant to a value of $g_{A\text{eff}} \approx 0.65\ g_A$ has been observed. A similar renormalization was found also in (p,n) reaction investigations. A theoretical interpretation of the observed effects has been discussed. 79 refs., 27 figs., 14 tabs. (author).

43497 (INP–1370/PL, pp. 59-82) **Fast rotating nuclei studies with Chateau de Cristal.** Beck, F.A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The French $4\pi\gamma$ multidetector system Chateau de Cristal has been used since 1985 in numerous experiments devoted to nuclear shape change and shape coexistence at high angular momentum as well as nuclear reaction mechanism studies. In the first kind of measurements a Chateau of 38 counters associated to 12 Ge with Compton suppressors has been used while in the second case the γ-particle and multiplicity measurements were done with a Chateau of 74 counters. The individual counters of Chateau de Cristal are BaF_2 crystals which I have developed for the first time as large γ detectors (efficient and fast). A summary of several experiments performed with Chateau de Cristal is presented. These data concern several fast rotating nuclei studies ranging from A ≈ 120 to A ≈ 200. 25 refs., 13 figs. (author).

43498 (INP–1370/PL, pp. 99-149) **High-spin research with HERA.** Diamond, R.M. (Lawrence Berkeley Lab., CA (USA)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Some of the results obtained using High Energy-Resolution Array are discussed and the array is briefly described. Two types of studies are presented: observation of superdeformed bands in the light Nd isotopes and rotational damping at high spin and excitation energy in the continuum γ-ray spectrum. 31 refs., 19 figs. (M.F.W.).

43499 (INP–1370/PL, pp. 293-306) **Nuclear structure close to ^{100}Sn.** Grawe, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

It is shown that with a highly selective apparatus involving multidetector arrays for γ-rays, neutrons and charged particles in-beam spectroscopy is possible as close as 3-4 nucleons to ^{100}Sn. Cross sections for selected exit channels from the heavy ion fusion-evaporation reaction ^{58}Ni + ^{46,48}Ti at 230 MeV are presented. The proton-proton and proton-neutron residual interactions in N=50 nuclei are studied. 18 refs., 6 figs. (M.F.W.).

43500 (INP–1370/PL, pp. 307-314) **Very high spin level structure of ^{148}Gd - onset of collectivity?.** Piiparinen, M. (Purdue Univ., Lafayette, IN (USA)); Drigert, M.W.; Janssens, R.V.F. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The level scheme of ^{148}Gd has been extended to I=46 by use of a Compton-suppressed Ge spectrometer array. Up to I=38 the observed level spectrum consists of spherical and oblate states of aligned single particle type. A change in structure along the yrast line is indicated at higher spins, where fast E2 transitions suggest the onset of collectivity. 22 refs., 3 figs. (author).

43501 (INP–1370/PL, pp. 397-402) **g-factor measurements in N=78 and N=82 nuclei.** Bazzacco, D. (Padua Univ. (Italy). Ist. di Fisica); Brandolini, F.; Lowenich, K. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Two different types of g-factor measurements of excited states were performed, namely the Time Differential Perturbed Angular Distribution (TDPAD) measurement of the two 10^+ states in ^{140}Sm and a systematic study of the first 2^+ states in the stable even isotones with N=82 performed with the transient field method. 8 refs., 2 figs. (M.F.W.).

43502 (INP–1370/PL, pp. 403-405) **Interplay of single particle and collective excitations in antimony nuclei.** Stan-Sion, C.

(Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The antimony nuclei are considered classical examples for coexisting spherical and well-deformed structures. The electromagnetic moment measurements presented in this paper provide direct evidence for shape coexistence. 8 refs., 3 figs. (M.F.W.).

43503 (INP–1370/PL, pp. 407-409) **Excited states in ^{111}Sb.** Berinde, A. (Institutul Central de Fizica, Bucharest (Romania)); Stan-Sion, C.; Iacob, V.E.; Parlog, M.; Trache, L. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

We report on the identification of excited states in ^{111}Sb. 3 refs., 2 figs. (author).

43504 (INP–1410/PH) **Evidence for intermittent patterns of fluctuations in particle production in high energy interactions in nuclear emulsion.** Holynski, R. (Institute of Nuclear Physics, Cracow (Poland)); Jurak, A.; Olszewski, A. Institute of Nuclear Physics, Cracow (Poland). Jun 1988. 18p. Order Number DE90635089. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The method of scaled factorial moments is used to study short range fluctuations in pseudorapidity distributions of particles produced in high energy interactions on nuclear targets. The intermittent behaviour of the fluctuations in proton and oxygen interactions in nuclear emulsion at various energies is shown. 10 refs., 6 figs., 2 tabs. (author).

6518 Nuclear Properties and Reactions, A = 150-189, Experimental

Refer also to citation(s) 43488, 43492, 43493, 43496, 43497, 43512

43505 (INP–1370/PL, pp. 1-14) **Population flow in and out of the superdeformed band in ^{152}Dy.** Herskind, B. (Niels Bohr Inst., Copenhagen (Denmark)); Broglia, R.A.; Lauritzen, B.; Schiffer, K. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Recently a superdeformed discrete band in ^{152}Dy extending up to I=60$\hbar$ was discovered and lifetime measurements verify the interpretation of the superdeformed shape with axis ratio of (1:2). This discovery constitutes a major break-through in the study of rapidly-rotating nuclei and confirms theoretical predictions. 12 refs., 7 figs. (author).

43506 (INP–1370/PL, pp. 83-97) **Superdeformed bands at high spin in Z=60, 66 and 68 isotopes.** Voigt, M.J.A. de (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.); Bacelar, J.C.; Riezebos, H.J. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The nucleus ^{152}Dy, with sharp ridges in the γ-γ -energy correlation matrix, stands out as a single case among three neighboring nuclei, which exhibit less pronounced structures. The ridges include the observed discrete superdeformed (SD) band, but must be composed mainly of unresolved superdeformed bands, which decay predominantly to less deformed states. A simple decay model is proposed, based on the possible lowering in energy of one SD band due to shell (and/or pairing) effects. SD bands with $\beta \simeq 0.4$-0.5 and with spins up to ≈ 40, were found in ^{134,135,136}Nd. The band in ^{135}Nd is the most strongly populated of all SD bands observed so far and the only one with established connections to known low-lying yrast states. 13 refs., 6 figs. (author).

43507 (INP–1370/PL, pp. 151-159) **DSA lifetime measurements of high spin states.** Emling, H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)). Argonne National Laboratory-Purdue University, University of Notre Dame Collaboration. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

We have performed DSA lifetime measurements for the series of isotopes ^{154,155,156}Dy at the Argonne-Notre Dame γ-ray facility. Doppler broadened γ-ray lineshapes could be extracted for (near) yrast states with spins as high as 44$\hbar$. The lineshapes were analysed by simulating (Monte Carlo) the slowing down process of the recoiling Dy isotopes emerging from the reaction ^{122,124}Sn (^{36}S,xn) into ^{208}Pb material and adjusting the lifetimes of the involved excited states in a least square minimalisation. We have studied the transitional Dy isotopes with neutron numbers N=88-90, first results will be presented for the ^{156}Dy isotope. It appears that the measurement of lifetimes could be extended into a regime of spins where collective structures and terminating single particle configurations coexist in the vicinity of the yrast line. 13 refs., 7 figs. (author).

43508 (INP–1370/PL, pp. 161-181) **Feeding and decay of a high spin isomer in ^{182}Os. Microscopy of osmium levels.** Sletten, G. (Niels Bohr Inst., Copenhagen (Denmark)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

High spin states where the spin is aligned to the deformation axis so-called deformation aligned states, in particular in ^{182}Os are discussed. The decay of the 130 ns isomeric state and the structures feeding are presented. Six different decay branches from the isomeric level have been identified and discussed. 10 refs., 9 figs. (M.F.W.).

43509 (INP–1370/PL, pp. 231-247) **Extending the spectroscopy around A = 130.** Kirwan, A.J. (Liverpool Univ. (UK). Oliver Lodge Lab.). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Technical advances at Daresbury Laboratory, in gamma-ray spectroscopy and mass identification have enabled rapid progress to be made in the spectroscopy of the transitionally deformed mass 130 region. The study of very high spin states in the region has revealed superdeformed structures in several nuclei. The Recoil Mass Separator at Daresbury has provided a powerful means of identifying the low lying states of previously unobserved very neutron deficient nuclei which have small formation cross sections (typically a few mb or less). 14 refs., 12 figs. (author).

43510 (INP–1370/PL, pp. 315-327) **The low-frequency $\pi h_{9/2}$ crossing in ^{184,185}Pt and ^{183}Ir.** Riedinger, L.L. (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics); Janzen, V.P.; Carpenter, M.P. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet

Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

In this paper, it is the goal to review the evidence for the existence of two band crossings in N=106 nuclei at very low and nearly degenerate rotational frequencies, to show the theoretical explanation for these two crossings ($\nu i_{13/2}$ and $\pi h_{9/2}$), and to present meaurements on M1/E2 branching ratios in high-K bands in ^{185}Pt and in ^{183}Ir to prove conclusively that indeed the $\pi h_{9/2}$ band crossing occurs at an amazingly low frequency. 18 refs., 6 figs. (author).

6519 Nuclear Properties and Reactions, A = 190-219, Experimental

Refer also to citation(s) 43441, 43487, 43488, 43493, 43497, 43536

43511 (GSI–90-10) **Reactions between very heavy atomic nuclei near and below the Coulomb barrier.** Funke, F. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Fachbereich 19 - Chemie und Pharmazie. May 1990. 146p. (In German). Order Number DE90512915. Source: NTIS (US Sales Only), PC A07/MF A01.

In the present thesis nuclear reactions in the collisional systems ^{238}U + ^{238}U, ^{238}U + ^{197}Au, and ^{197}Au + ^{197}Au were studied at energies at and below the Coulomb barrier. The present measurements show that the transfer of one neutron is the farly dominating reaction channel with mass transfer. Because of the very sensitive radiochemical measuring method the transfer of up to 15 nucleons could be detected. A reaction channel comparable in the strength with the 1n transfer is the fission, composed of fission after purely electromagnetic excitation and fission after nucleon transfer. (orig./HSI) With 69 refs., 35 figs., 46 tabs.

43512 (INDC(NDS)–234, pp. 91-106) **Neutron spectra from the (p,n) reactions on the ^{165}Ho, ^{204}Pb, ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{209}Bi nuclei and nuclear level density.** Zhuravlev, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Birukov, N.S.; Rudenko, A.P.; Titarenko, N.N.; Trykova, V.I. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169–: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Neutron spectra from the (p,n) reaction on the ^{165}Ho, ^{207}Pb, ^{208}Pb, ^{209}Bi nuclei have been measured at the proton energy of 6.95±0.15 MeV. The experimental data together with the data obtained earlier at E_p=1 MeV on the ^{165}Ho, ^{204}Pb, ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{209}Bi nuclei have been analyzed within the framework of a statistical nuclear reaction theory using the generalized model of a superfluid nucleus for the nuclear level density. The absolute nuclear level density has been determined in a wide range of excitation energies. (author). 16 refs, 7 figs, 4 tabs.

43513 (INP–1370/PL, pp. 269-291) **Spectroscopy of Fr nuclei.** Byrne, A.P. (Bonn Univ. (Germany, F.R.). Inst. fuer Strahlen- und Kernphysik). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The level schemes for ^{213,212,211}Fr are deduced from the experiments performed at Australian National University in Canberra and it is shown that these nuclei can also be described well in terms of the "single particle" picture. The E3 transitions which dominate the structure of this region are studied. In the second part of the paper a measurement performed at the Hahn-Meitner-Institut is discussed, in which an expected long lived high-spin isomer in ^{213}Fr was searched. 13 refs., 9 figs. (M.F.W.).

6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

Refer also to citation(s) 43511, 43534

43514 (GSI–90-27(prepr.)) **Informations on octupole correlations in light actinide nuclei.** Wollersheim, H.J. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 12p. (CONF-9005254–: 3. international spring seminar on nuclear physics: understanding the variety of nuclear excitations, Ischia (Italy), 21-25 May 1990). Order Number DE90512896. Source: NTIS (US Sales Only), PC A03/MF A01.

Experimental evidence for octupole correlations, which lead to octupole instability and octupole deformation of some nuclei, is illustrated through typical examples. Data are considered for the light actinide nuclei which have been studied up to moderately high spins. In case of ^{226}Ra most of the electric dipole, quadrupole and, for the first time, octupole transition moments have been measured up to spin 18 for yrast states. (orig.).

43515 **Neutron absorption cross section of ^{236}U.** Macklin, R.L. (Oak Ridge National Lab., TN (USA)); Alexander, C.W. *Nuclear Science and Engineering (USA),* 104(3): 258-270 (Mar 1990). DOE Contract AC05-84OR21400.

Uranium-236 neutron absorption is measured as a function of neutron time of flight from 20 eV to 1 MeV. The neutron flux is monitored with a ^{6}Li glass scintillator. Average cross sections from 3 keV to 1 MeV are derived. Estimated uncertainties are < 5% below 600 keV and increase to 9.5% at 1 MeV. From 20-eV to 4.2-keV neutron energy, 293 resonance peaks are parameterized.

6530 Nuclear Theory

Refer also to citation(s) 43136, 43443, 43469, 43470, 43510

43516 (CBPF-NF–019/89) **Total cross section of ultra-relativistic heavy ion collisions.** Kodama, T. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 20p. Order Number DE90635034. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A possible increase of nuclear cross section at ultra-relativistic energies is suggested. Such an increase is expected to start much earlier than in the case of proton-proton reactions due to more diffused nuclear surface compared to that of proton. Experimental data seem to be consistent with this picture. (author).

43517 (GSI–90-25(prepr.)) **Coupled-channel equations and gauge transformations.** Rumrich, K. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 6p. Order Number DE90512898. Source: NTIS (US Sales Only), PC A02/MF A01.

We demonstrate that the gauge invariance in the coupled-channel representation of the Dirac equation is violated if the basis set is truncated. (orig.).

43518 (GSI–90-26(prepr.)) **Intermittency pattern of fluctuations in nuclear multifragmentation.** Ploszajczak, M. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Tucholski, A. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). May 1990. 15p. Order Number DE90512897. Source: NTIS (US Sales Only), PC A03/MF A01.

The method of scaled factorial moments is used to study fluctuations of the fragment size distribution in the percolation model and in nuclear multifragmentation following the breakup of the high energy nuclei in the nuclear emulsion. The percolation model accounts well for the fluctuations in the nuclear fragmentation process. An intermittent pattern of fluctuations is found in the data suggesting a self-similarity in the fragment size distribution and a

random character for the scaling law. However, no evidence of the critical behaviour in nuclear multifragmentation is found. (orig.).

43519 (HMI-B-473) **Transfer of nucleons between nuclei.** Oertzen, W. von (Freie Univ. Berlin (Germany, F.R.)). Hahn-Meitner-Institut Berlin GmbH (Germany, F.R.). Sep 1989. 92p. (CONF-8907154--: Enrico Fermi summer course CX11: nuclear collisions from the mean field into the fragmentation regime, Varenna (Italy), 11-21 Jul 1989). Order Number DE90512917. Source: NTIS (US Sales Only), PC A05/MF A01.

The author presents an introductory review about the properties and dynamics of nuclei, which are connected with the change of the nucleon number as it is caused by nucleon transfer. Especially he considers the single-nucleon transfer close to the barrier with the two-center problem and dissipation in heavy systems, pairing in connection with two-nucleon and cold multinucleon transfer considering also dissipation and fission, and transfer and fragmentation processes at higher energies. (HSI) With 67 refs., 44 figs.

43520 (IFT-P-09/89) **Field theoretical approach to proton-nucleus reactions: II-Multiple-step excitation process.** Eiras, A. (Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil)); Kodama, T.; Nemes, M. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). 1989. 27p. Order Number DE90635035. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A field theoretical formulation to multiple step excitation process in proton-nucleus collision within the context of a relativistic eikonal approach is presented. A closed form expression for the double differential cross section can be obtained whose structure is very simple and makes the physics transparent. Glauber's formulation of the same process is obtained as a limit of ours and the necessary approximations are studied and discussed. (author).

43521 (IFUSP-P-775) **Symmetrical representation of the transition matrix II: relativistic extensions.** Hussein, M.S.; Spehler, D.; Marques, G.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Feb 1989. 58p. Order Number DE90635036. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The recently developed theory of the symmetrical T-matrix is extended here to relativistic scattering. The new symmetrical relativistic T-matrix is then used to study eikonal-type representations. It is shown that in the high-energy limit, our results tend to the Levy-Sucher representations known to be a good approximation even at large angles. (author).

43522 (INDC(NDS)-234, pp. 31-37) **Extraction of level density from excitation functions of threshold reactions.** Grudzevich, O.T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Ignatyuk, A.V.; Plyaskin, V.I.; Zelenetsky, A.V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169--: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The possibility of extraction of the nuclear level density from excitation function of threshold reactions is discussed. It is demonstrated that the data obtained are in good agreement both with the results of the evaporation spectra analysis and with systematics of neutron resonance density and resolved levels. 11 refs, 2 figs.

43523 (INDC(NDS)-234, pp. 39-42) **Nuclear level densities from particle yields and spectra in proton induced reactions on molybdenum isotopes.** Kataria, S.K. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.); Kumar, K.; Ramamurthy, V.S.; Blann, M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169--: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The inclusive energy and angular distribution of neutrons at 13.13 and 25.6 MeV and of protons and alphas at 18 MeV in several isotopes of Mo(p,x) have been reported recently where x is either a neutron or proton or an alpha particle. In the present work, we have used modified ALICE Code to calculate the energy spectra as well as integral yields of the various particles emitted. This modified ALICE code has a new option to use shell dependent nuclear level density formula which smoothly goes over to Fermi Gas Model expressions at high excitation energies in a realistic manner. The calculated neutron energy spectra and yields do not depend significantly on the use of either Fermi Gas Model option or the shell dependent option. The calculated yields and the energy spectra of protons and alpha particles does depend on the level density option being used. (author). 8 refs, 2 figs, 1 tab.

43524 (INDC(NDS)-234, pp. 43-51) **"Contamination" of neutron evaporation spectra by direct and pre-equilibrium processes.** Kalka, H. (Technische Univ., Dresden (German Democratic Republic)); Maerten, H.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169--: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Contributions of direct and pre-equilibrium processes to secondary-neutron spectra in (n,n') and (p,n) reactions are analysed in the framework of the SMD/SMC theory. Specifically, statistical multistep-compound reactions (SMC) based on the closed solution of the Pauli master equation are shown to be a superposition of equilibrium and pre-equilibrium contributions. Results are presented for the reactions ^{93}Nb(n,n') and ^{109}Ag(p,n). (author). 8 refs, 6 figs.

43525 (INDC(NDS)-234, pp. 53-55) **Integral test of level density descriptions in the framework of fission neutron theory.** Maerten, H. (Technische Univ., Dresden (German Democratic Republic)); Seeliger, D.; Arnold, K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1990. (CONF-8911169--: 3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions, Bologna (Italy), 13-15 Nov 1989). In *Measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions: Proceedings of the final meeting of a co-ordinated research programme held in Bologna, Italy, 13-15 November 1989.* Order Number DE90635061. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Several methods for the semi-empirical description of nuclear level density have been tested within the complex cascade evaporation model (CEM). The standard neutron spectrum from spontaneous fission of ^{252}Cf can be well reproduced if taking into account shell and pairing effects in a reliable manner. (author). 10 refs, 2 figs.

43526 (INP-1370/PL, pp. 15-57) **Some aspects of three dimensional cranking.** Bengtsson, R. (Lund Inst. of Tech. (Sweden). Dept. of Mathematical Physics); Frisk, H.; Chong-shi Wu. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201--: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Some basic properties of triaxially deformed nuclei, rotating about a non-principal axis, have been investigated. It is found that under certain conditions rotation about a non-principal axis is energetically favoured. 10 refs., 19 figs. (author).

43527 (INP–1370/PL, pp. 249-268) **Something old and something new.** Irvine, J.M. (Manchester Univ. (UK). Dept. of Theoretical Physics). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The problem of nuclear saturation as well as the observations of supernova SN1987a are discussed. 19 refs., 10 figs. (M.F.W.).

43528 (INP–1370/PL, pp. 203-230) **Recent developments in heavy-ion induced fission.** Newton, J.O. (Australian National Univ., Canberra (Australia). Research School of Physical Sciences). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Results of detailed statistical model analysis of data on nuclei with a wide range of fissility are presented. Measurements of pre-fission neutrons deviate from the statistical model predictions, and the implications of these regarding nuclear dynamics and the statistical model parameters are discussed. 28 refs., 15 figs. (author).

43529 (INP–1370/PL, pp. 337-340) **Octupole instability in the heavy barium region.** Nazarewicz, W. (Florida State Univ., Tallahassee, FL (USA)); Leander, G.A.; Tabor, S. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The Woods-Saxon-Bogolyubov cranking calculations confirm previous expectations of octupole deformed mean fields at low and medium spins in Xe-Sm nuclei with neutron numbers around N=86. Recent experimental data support theoretical results. 8 refs., 3 figs. (author).

43530 (INP–1370/PL, pp. 375-383) **Coherent particle and quasiparticle pairs determined from the Hartree-Fock approach.** Dobaczewski, J. (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej); Skalski, J. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

We have compared two methods for analyzing the mean-field states resulting from the constrained Hartree-Fock + BCS calculations. The first one consists in presenting this state as an exponent of a coherent-particle-pair creation operator acting on the bare vacuum and then performing the multipole expansion of the pair. The second one is based on the similar presentation in terms of the coherent-quasiparticle-pair creation operator and the spherical quasiparticle vacuum. It is shown that the particle number and binding energy obtained for a truncated quasiparticle pair are much closer to the Hartree-Fock results than those obtained for a truncated particle pair. The variation-after-truncation calculations indicate that the particle pairs obtained from the Hartree-Fock method are far from being optimal, while the quasiparticle pairs obtained from the same method are very close to be optimal ones. 21 refs., 12 figs. (author).

43531 (INP–1370/PL, pp. 385-388) **Theoretical aspects of superdeformation in ^{152}Dy.** Werner, T. (Warsaw Univ. (Poland)); Dudek, J.; Nazarewicz, W.; Szymanski, Z. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. Contract CPBP 01.09. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Selected results of the calculations in which we analysed the temperature properties of the barrier that separates "normal" (low deformation) and superdeformed configurations on a potential energy landscape are presented. Such barriers may be then used to estimate the decay probability of superdeformed states. 6 refs., 3 figs. (author).

43532 (INP–1370/PL, pp. 371-374) **Isoscalar macroscopic surface response in the nucleon-nucleus interaction.** Abrosimov, V.I. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Fiziki). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The surface response of the semi-infinite nuclear matter for a low momentum and energy transfers, in the nucleon-nucleus interaction is studied. 7 refs., 1 fig. (M.F.W.).

43533 (INP–1370/PL, pp. 329-335) **Synthesis and properties of the heaviest nuclei.** Sobiczewski, A. (Institute for Nuclear Studies, Otwock-Swierk (Poland)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The scope of the present paper is to give a short review of recent theoretical results for the properties of the heaviest nuclei. The properties are mainly: the spontaneous-fission, T_{sf} and alpha-decay, T_α, half-lives. However, such quantities like the shell correction to the energy (mass) of a nucleus, δE_{sh}, the fission barrier, E_f, and alpha-decay energy, Q_α are also discussed. Even-even nuclei are considered. 13 refs., 7 figs. (author).

43534 (INP–1370/PL, pp. 393-395) **Description of the mass distribution in heavy-ion collisions.** Adeev, G.D. (Omskij Gosudarstvennyj Univ., Omsk (USSR)); Pashkevich, V.V.; Saupe, G. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The calculations of the fragment mass distribution observed in the reactions ^{22}Ne(174 MeV) + ^{249}Cf and ^{40}Ar(301 MeV) +^{232}Th are presented. In the calculations two sets of the liquid-drop potential parameters have been used. The results are in reasonable agreement with the experimental data. 7 refs., 2 figs. (M.F.W.).

43535 (INP–1370/PL, pp. 433-436) **The influence of the zero point vibration energy on the multipole moments of nuclei.** Nerlo-Pomorska, B. (Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The multipole moments of nuclei are calculated within the generator-coordinate method. The calculation is performed for the rare earth nuclei. 2 refs., 6 figs. (M.F.W.).

43536 (INP–1370/PL, pp. 411-417) **The dependence of high-energy gamma-ray emission on the mass asymmetry in the entry channel in heavy ion reactions.** Kamanin, V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Kugler, A.; Penionzhkevich,

Yu.E.; Sobolev, Yu.G.; Fomichev, A.S.; David, I. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987. Part 1: Selected topics in nuclear structure.* Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

The dependence of the yield of high energy gamma transitions on the parameter entry channel has been investigated for : -fusion-fission channel - Bi* compound nucleus, from reactions (^{159}Tb + ^{40}Ar (220 MeV, 300 MeV), ^{181}Ta + ^{22}Ne (155 MeV), ^{192}Os + ^{15}N (147 MeV)); -fusion-evaporation channel - ^{132}Nd* compound nucleus, from reactions (^{68}Zn + ^{64}Zn (290 MeV) and ^{112}Sn + ^{20}Ne (110 MeV)). We have tried to formulate the qualitative description of gamma emission at the first stages of fusion reaction. 14 refs., 8 figs. (author).

43537 (INP–1386/PL) **Extended RPA study of nuclear collective phenomena.** Drozdz, S. Institute of Nuclear Physics, Cracow (Poland). 1987. 94p. Order Number DE90635013. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

A fully microscopic study of nuclear collective phenomena is presented within the framework of an extended RPA which includes 1p-1h and 2p-2h excitations in a consistent way. This theory allows us to obtain a very realistic description of various excitation spectra. As a result, a strong evidence of correlation effects beyond mean-field theory emerges. The effective interaction used is a G-matrix derived from the meson-exchange potential. The extended theory introduces also additional correlations which screen the long-large part of the effective interaction. This effect significantly enhances the stability of the ground state against density fluctuations. In this connection a possible importance of relativistic effects is also discussed. 99 refs., 19 figs., 5 tabs. (author).

43538 (INP–1393/PH) **Nucleon structure and properties of dense matter.** Kutschera, M. (Institute of Nuclear Physics, Cracow (Poland)); Pethick, C.J. Institute of Nuclear Physics, Cracow (Poland). 1988. 24p. (CONF-8709494–: Workshop on physics of intermediate and high energy heavy ion reactions, Cracow (Poland), 28 Sep 1987). Order Number DE90635029. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We consider the properties of dense matter in a framework of the Skyrme soliton model and the chiral bag model. The influence of the nucleon structure on the equation of state of dense matter is emphasized. We find that in both models the energy per unit volume is proportional to $n^{4/3}$, n being the baryon number density. We discuss the properties of neutron stars with a derived equation of state. The role of many-body effects is investigated. The effect of including higher order terms in the chiral lagrangian is examined. The phase transition to quark matter is studied. 29 refs., 6 figs. (author).

43539 (INP–1411/PH) **Debye's length in expanding quark-gluon plasma.** Bialas, A. (Uniwersytet Jagiellonski, Cracow (Poland). Inst. Fizyki); Broniowski, W.; Czyz, W. Institute of Nuclear Physics, Cracow (Poland). Jun 1988. 19p. Order Number DE90635030. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The screening properties of an abelian quark-gluon plasma and boost invariantly expanding in a given direction, are discussed. The expansion results in anisotropic screening. At early stages of the process, the Debye length along the direction of the expansion is reduced by a factor of about 2, relative to static calculations. This may have important consequences for the J/ψ production rate. 12 refs., 2 figs., 1 tab. (author).

43540 (INP–1431/PL) **Magnetic properties of strongly asymmetric nuclear matter.** Kutschera, M. (Institute of Nuclear Physics, Cracow (Poland)); Wojcik, W. Institute of Nuclear Physics, Cracow (Poland). 1988. 14p. Order Number DE90635031. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We investigate stability of neutron matter containing a small proton admixture with respect to spin fluctuations. We establish conditions under which strongly asymmetric nuclear matter could acquire a permanent magnetization. It is shown that if the protons are localized, the system becomes unstable to spin fluctuations for arbitrarily weak proton-neutron spin interactions. For non-localized protons there exists a threshold value of the spin interaction above which the system can develop a spontaneous polarization. 12 refs., 2 figs. (author).

43541 (INP–1433/PH) **Screening in an expanding quark-gluon plasma.** Broniowski, W. Institute of Nuclear Physics, Cracow (Poland). Dec 1988. 14p. (CONF-8811172–: Hadron structure' 88, Piestany (Czechoslovakia), 14-18 Nov 1988). Order Number DE90635032. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Effects of expansion on the Debye length in quark-gluon plasma are calculated in an abelian, boost invariant model. It is found that for early times the screening is significantly more efficient than what follows from naive static considerations. 11 refs., 1 fig., 1 tab. (author).

43542 (JINR–7-33-88, pp. 54-62) **The effect of the shell closure on nuclear excited state energies.** Morozov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The identification of new magic and semimagic nuclei and the discovery of the shell and subshell closure effects permit one to determine the limits of applicability of a shell model or its modifications. The aim of this work was to choose the methods of identification of closed shells in a nucleus. The method for differentiation of energy surface of excited states of a definite nature was applied for the first time. It permitted one to discover the closure of shells, subshells and quasishells in nuclei of spherical, transitional and deformed region. The closure of a neutron subshell at N=56 and of a proton subshell at Z=58 was shown. 7 refs.; 9 figs.

43543 (JINR–7-33-88, pp. 63-70) **Effect of the shell closure on the probabilities of electromagnetic transitions in a nucleus.** Morozov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

It has been discovered that M1-,M2-,M4-type magnetic transitions can serve a probe to identify the shell closure in nuclei. The fact has been established of correspondence to one-particle limit of the ratio of reduced probabilities of proton and neutron transitions for nuclei, having even-even magic core $\pm$ 1 nucleon. It can contribute to determining the zones of action of magic numbers and to predicting the probabilities for proton and neutron transitions in various odd nearmagic nuclei. 5 refs.; 6 figs.; 1 tab.

43544 (JINR–7-33-88, pp. 47-53) **Search for global maximum position in the problem of reaction coordinates reconstruction.** Yatsunenko, Yu.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications: Collection.* Order Number DE90706118. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The method of searching for the global maximum position is described. As applied to the problem of coordinate determination of the particle interaction with reaction products having straight trajectories. The method is based on minimization of the excess of function, symmetrized with respect to the desired point, that permits to analyze the discrete functions. 6 refs.; 2 figs.

43545 (LA-UR–90-2258) **Monte Carlo approaches to light nuclei: Structure and electron scattering.** Carlson, J. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9005238–2: Symposium in honor of Akito Arima: nuclear physics in the 1990's, Santa Fe, NM (USA), 1-5 May 1990). Order Number DE90015098. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Significant progress has been made recently in the application of Monte Carlo methods to the study of light nuclei. We review new

Green's function Monte Carlo results for the alpha particle, Variational Monte Carlo studies of ^{16}O, and methods for low-energy scattering and transitions. Through these calculations, a coherent picture of the structure and electromagnetic properties of light nuclei has arisen. In particular, we examine the effect of the three-nucleon interaction and the importance of exchange currents in a variety of experimentally measured properties, including form factors and capture cross sections. 29 refs., 7 figs.

43546 (LA-UR–90-2279) **Light-front nuclear shell-model.** Johnson, M.B. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9005251–1: Workshop on quark-gluon structure of hadrons and nuclei, Shanghai (China), 28 May - 1 jun 1990). Order Number DE90015033. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

I examine the effects of nuclear structure on high-energy, high-momentum transfer processes, specifically the EMC effect. For pedagogical reasons, a fictitious but simple two-body system consisting of two equal-mass particles interacting in a harmonic oscillator potential has been chosen. For this toy nucleus, I utilize a widely-used link between instant-form and light-front dynamics, formulating nuclear structure and deep-inelastic scattering consistently in the laboratory system. Binding effects are compared within conventional instant-form and light-front dynamical frameworks, with appreciable differences being found in the two cases. 20 refs.

6540 Radiation and Shielding Physics

Refer also to citation(s) 42598, 43186, 43216, 43288, 43568

43547 (INP–1343/PS, pp. 80-92) **Moessbauereffect with synchrotron radiation.** Gerdau, E. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik); Rueffer, R. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1986. (CONF-8604259–: 21. winter school of physics, Zakopane (Poland), 7-11 Apr 1986). In *Proceedings of 21. winter school on physics, Zakopane, Poland, 14-20 April, 1986. Part 2: Part 2. Condensed matter studies by nuclear methods.* Order Number DE90634553. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

Monochromatrization of synchrotron radiation by nuclear Bragg diffraction in YIG was obtained. This method of resonance filtering preserves the unique properties of synchrotron radiation which can now be combined with the high energy resolution of Moessbauer experiments. 11 refs., 6 figs. (author).

43548 (LA-UR–90-2268) **An even-parity/odd-parity formulation for deterministic transport calculations on massively parallel computers.** Morel, J.E.; Olvey, L.A.; Claborn, G.W.; Josef, J.A. Los Alamos National Lab., NM (USA). [1990]. 10p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9006195–4: Free Lagrange conference, Jackson Lake, WY (USA), 3-7 Jun 1990). Order Number DE90015036. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a highly parallel deterministic method for performing time-dependent particle (neutron, gamma-ray, or thermal radiation) transport calculations on arbitrarily connected 3-D tetrahedral meshes. The standard discrete-ordinates method, which is used to solve the first-order form of the transport equation, is extremely cumbersome to apply on such meshes and is based upon a mesh sweeping algorithm that is highly sequential in nature. A serial 1-D code for the CRAY-YMP and a parallel 1-D code for the CM-2 (Connection Machine) have been written to test our basic method. Comparisons between these two codes have shown that our new even/odd parity method is highly parallelizable. 10 refs., 2 figs.

43549 (RAL–90-017) **Spin and orbital magnetisation densities determined by Compton scattering of photons.** Collins, S.P. (Daresbury Lab. (UK)); Laundy, D.; Cooper, M.J.; Lovesey, S.W. Rutherford Appleton Lab., Chilton (UK). Mar 1990. 18p. Order Number DE90635005. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Compton scattering of a circularly polarized photon beam is shown to provide direct information on orbital and spin magnetisation densities. Experiments are reported which demonstrate the feasibility of the method by correctly predicting the ratio of spin and orbital magnetisation components in iron and cobalt. A partially polarised beam of 45 keV photons from the Daresbury Synchrotron Radiation Source produces charge-magnetic interference scattering which is measured by a field-difference method. Theory shows that the interference cross section contains the Compton profile of polarised electrons modulated by a structure factor which is a weighted sum of spin and orbital magnetisations. In particular, the scattering geometry for which the structure factor vanishes yields a unique value for the ratio of the magnetisation densities. Compton scattering, being an incoherent process, provides data on total unit cell magnetisations which can be directly compared with bulk data. In this respect, Compton scattering complements magnetic neutron and photon Bragg diffraction. (author).

6550 Medical Physics

Refer also to citation(s) 42750, 42751, 42758

43550 (CDTN-DERL-PD–003/83) **Individual monitoring service evaluation of CDTN.** Polastro, L.C.; Alonso, T.C. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 17 Mar 1983. 20p. (In Portuguese). Order Number DE90635348. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Results got by Individual Monitoring Service of CDTN-Centro de Desenvolvimento de Tecnologia Nuclear in 2nd Annual Intercomparison among individual monitoring services, promoted by CNEN-Comissao Nacional de Energia Nuclear are presented. An evaluation of results obtained in intercomparison for two types of "badge" subjected on test is made. These results were in the anticipate limits to dosimetry by films. (author).

43551 (CDTN-DERL-PD–008/84) **Radiological control in fires involving radiation sources.** Franco, J.O.A.; Coelho, C.P. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1984. 28p. (In Portuguese). Order Number DE90635331. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The copies used during the chatter by techniques from CDTN in the I Mineiro Symposium of Fire Engineering, are presented. The chatter was based on emergency radiation control course, given by CDTN. Basic concepts, such as nuclear physics fundaments, radiation nature and detection, radiation protection and practical aspects of radiological fire emergency, were enphasized. (M.C.K.).

6560 Condensed Matter Physics

Refer also to citation(s) 42964, 42979, 42980, 42981, 42982, 43019, 43020, 43021, 43023, 43024, 43136, 43178, 43191, 43217, 43221, 43547

43552 (CBPF-NF–004/89) **Magnetic properties of $Ce(Fe_{1-x}Al_x)_2$ (Al-rich side).** Takeuchi, A.Y.; Cunha, S.F. da. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 26p. Order Number DE90634539. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Magnetic properties of the Laves phase system $Ce(Fe_{1-x}Al_x)_2$ were investigated by means of magnetization and electrical resistivity measurements for $0.60 <= X < 0.90$. X-ray powder diffratograms reveal that at least up to 40% of iron in $CeAl_2$ ($x=0.60$) the samples are single-phase. A magnetic phase diagram is proposed where, in this range concentration, the system changes from a ferromagnetic to a quasi ferrimagnetic phase around $x=0.80$. At low temperatures the mixed phase character was indicated by spin-glass behaviour, walls pinning of ferromagnetic domains and frustration. (author).

43553 (CBPF-NF–017/89) **Criticality of the discrete N-vector ferromagnet in planar self-dual lattices.** Mariz, A.M. (Rio Grande do Norte Univ., Natal, RN (Brazil). Dept. de Fisica); Silva, L.R. da; Stella, A.; Tsallis, C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 31p. Order Number

DE90634540. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An extended version of the discrete N-vector (or cubic) ferromagnetic model withon a real space renormalization group approach which preserves the two-spin correlation function is studied. The N-evolution (for real values of N) of the Wheatstone-bridge hierarchical lattice phase diagram, which presents paramagnetic, intermediate (nematic-like) and ferromagnetic phases, as well as of the thermal υ and crossover ϕ critical exponents, is presented. The self-avoiding walk problem is recovered in the N → O limit, and the so called "corner-rule" is reobtained in a larger context. The Ising, N- and 2N-state Potts ferromagnets are recovered as particular cases. An interchange of stability occurs at $N=N^* \simeq 6.9$ in such a way that the 2N-state Potts special point (were all three existing phases join) is a multicritical one if $N<N^*$ but only a critical one if $N>N^*$ (consistently $\phi(N^*)=0$). For the cubic model, $\upsilon(N)$ presents a maximum at $N=N_{max} \simeq 1.5$. The results are exact, for all N, for the Wheatstone-bridge hierarchical lattice, and approximate, for $N \leq 2$, for the square lattice. The connection between the present approach and the phenomenological renormalization group, is discussed. (author).

43554 (CBPF-NF–073/88) **Z(λ) model and flows: subgraph break-collapse method.** Essam, J.W. (Royal Holloway Coll., Egham (UK). Dept. of Mathematics); Magalhaes, A.C.N. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 37p. Order Number DE90634536. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A recursive algorithm previously developed for the λ-state Potts model is generalised to the Z(λ) model. The relations used are based on an expression we derive for the pair correlation function in terms of mod-λ flows, which represents an extension of a similar result for the partition function previously obtained by Biggs. The use of flows enables us to prove and extend the formulae which appear in the break-collapse method of Mariz and coworkers. It is argued that the use of of fixed-flow bonds rather than the precollapsed bonds used by the latter authors leads to a more efficient algorithm. (author).

43555 (CBPF-NF–074/88) **The n-component cubic model and flows: subgraph break-collapse method.** Essam, J.W. (Royal Holloway Coll., Egham (UK). Dept. of Mathematics); Magalhaes, A.C.N. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 35p. Order Number DE90634537. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We generalise to the n-component cubic model the subgraph break-collapse method which we previously developed for the Potts model. The relations used are based on expressions which we recently derived for the Z(λ) model in terms of mod-λ flows. Our recursive algorithm is similar, for n = 2, to the break-collapse method for the Z(4) model proposed by Mariz and coworkers. It allows the exact calculation for the partition function and correlation functions for n-component cubic clusters with n as a variable, without the need to examine all of the spin configurations. (author).

43556 (CBPF-NF–076/88) **Magnetic ordering of $YBa_2(Cu_{1-x}Fe_x)_3O_7$.** Litterst, F.J. (Technische Univ., Muenchen (Germany, F.R.). Dept. of Physics); Saitovitch, E.B.; Azevedo, I.S.; Scorzelli, R.B. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 14p. Order Number DE90634541. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The Moessbauer spectra of $YBa_2(Cu_{1-x}Fe_x)_3O_7$ at room temperature show several doublets attributed to Fe in Cu(1) sites with different oxygen configurations. Here we present a systematic study performed at 4.2K for x=0.005, 0.01, 0.03, 0.05, 0.10, 0.15. To obtain information about the magnetic ordered state two samples, with x=0.005 and x=0.15, have been studied at 4.2k under B_{ext}=5T. The Moessbauer spectra indicate that iron moments are polarized for X=0.005, while in the ordered state (x=0.15) they have an antiferromagnetic or spin-glass-like arrangement with high anisotropy. (author).

43557 (CBPF-NF–079/88) **Magnetic phase present in $YBa_2(Cu_{1-x}Fe_x)_3O_{6+\delta}$ oxides.** Saitovitch, E.B.; Azevedo, I.S.; Scorzelli, R.B. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 14p. Order Number DE90634542. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The Moessbauer study of ^{57}Fe: $YBa_2Cu_3O_{6+\delta}$ oxides was very important to establish the preferential occupation of Cu(1) site by Fe at very low concentrations. Recent determination of antiferromagnetic ordering for Cu moments in Cu (2) sites (T ≈450K) and our early observation of a small proportion of a magnetic phase at room temperature for Fe:$YBa_2Cu_3O_6$ lead us to perform systematic studies of $YBa_2(Cu_{1-x}Fe_x)_3O_6$ with x = 0.005, 0.03, 0.05, 0.10 and 0.15 in order to obtain information about the occupation of Cu(2) sites. (author).

43558 (CBPF-NF–081/88) **Hyperfine interactions associated with iron substituted superconducting oxides.** Ellis, D.E. (Argonne National Lab., IL (USA)); Dunlap, B.D.; Kimball, C.M.; Saitovitch, E.B.; Azeredo, I.S.; Scorzelli, R.B. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 12p. Order Number DE90634543. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Theoretical and experimental Moessbauer spectroscopy studies have been made concerning charge and spin densities and magnetic hyperfine fields (H_{hf}) in iron-substituted superconducting oxides. Calculations were carried out in the self-consistent-field embedded cluster model using local density theory (SCF-Xα) with a variational atomic orbital basis. Spectral densities and changes in charge and spin density were monitored around neighboring Cu sites, as well as Fe impurity site, in $La_2C_{1-x}Fe_xO_y$ and $YBa_2Cu_{3-x}Fe_xO_{7-y}$ compounds. Moessbauer isomer shifts (IS), quadrupole splittings (QS) and H_{hf} are obtained by fitting multiline models to the observed spectra and are compared with SCF-Xα results for specific lattice sites. The influence of oxygen vacancies and partial oxygen disorder is modelled and compared with the experimental data on variable oxygen content and disorder. (author).

43559 (CBPF-NF–082/88) **Moessbauer studies of $(La_{1-x}Ba_x)_2CuO_4$ superconducting oxides.** Saitovitch, E.B.; Azevedo, I.S.; Scorzelli, R.B.; Saitovitch, H.; Cunha, S.F. da; Guimaraes, A.P.; Silva, P.R.; Sampaio, L.C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 10p. Order Number DE90634544. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Samples with Cu substituted by small amount of iron (less than 1%) were prepared for x = 0.15, 0.25 and 0.35 mixtures. Despite the fact that there is only one Cu site in the $(La_{1-x}Ba_x)_2CuO_4$ compounds the Moessbauer spectra at room temperature indicated the presence of two quadrupole doublets whose behaviour were followed in different steps of sample preparation. They are mostly characteristic of Fe^{+3} and one of them may be due to the presence of Oxygen or Lanthanium vacancies. The existence of magnetic ordering is investigated by ^{57}Fe Moessbauer measurements at 4.2K for samples with 0.5% Fe. (author).

43560 (CBPF-NF–083/88) **Paramagnetic hyperfine interactions of iron in solid ammonia from Moessbauer spectroscopy.** Litterst, F.J. (Technishe Univ. Muenchen, Garching (Germany, F.R.). Dept. of Physik); Saitovitch, E.M.B.; Terra, J. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 25p. Order Number DE90634545. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Moessbauer studies on highly dilute ^{57}Fe in solid ammonia are reported. The hyperfine parameters of the paramagnetic reaction product $FeNH_3$ point to a nearly atomic configuration of iron $[Ar]3d^74s$. The electronic spin relaxation slows down rapidly under application of an external magnetic field. The field dependence of the magnetic hyperfine patterns indicates a strong axial magnetic anisotropy. (author).

43561 (CRN-CPR–89-02) **Photodecomposition of Hg - Photo - CVD monosilane. Application to hydrogenated amorphous silicon thin films.** Aka, B. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Apr 1989. 185p. (In French). Order Number DE90511918. Source: NTIS (US Sales Only), PC A09/MF A01.

The construction of a Hg-photo-CVD device is discussed. The system enables the manufacturing of hydrogenous thin films of

amorphous silicon from monosilane compound. The reaction mechanisms taking place in the gaseous phase and at the surface, and the optimal conditions for the amorphous silicon film growth are studied. The analysis technique is based on the measurement of the difference between the condensation points of the gaseous components of the mixture obtained from the monosilane photolysis. A kinetic simplified model is proposed. Conductivity measurements are performed and the heat treatment effects are analyzed. Trace amounts of oxygen and carbon are found in the material. No Hg traces are detected by SIMS analysis.

43562 (CTA-IEAv-RP–004/88) **On the equivalence of different Landau expansions for the Curie-Weiss model.** Carneiro, C.E.I.; Henriques, V.B.; Salinas, S.R. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Mar 1988. 25p. Order Number DE90634546. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The critical behavior of a Curie-Weiss model may be obtained from the standard Landau expansion, in powers of the magnetization order parameter m, from the functional $\psi(T,H;m) = -Hm + pound(T,m)$, where pound is the Helmholtz free energy. As an alternative procedure, the Gibbs free energy, g(T,H), is obtained as the minimum of a functional g(T,H;y) with respect to a continuous spin field y and the critical behavior is analysed from an expansion of this functional in powers of y. We show that, in spite of displaying quite distinct coefficients, both expansions lead to the same critical behavior. The Ising ferromagnetic model is discussed in detail for pedagogical reasons. We also obtain the relations between the coefficients of the two expansions for a more general case. We remark that these distinctions are already present in different strategies to obtain a suitable Landau-Ginzburg-Wilson hamiltonian for performing a momentum-space renormalization-group calculation. (author).

43563 (CTA-IEAv-RP–021/88) **Mean field analysis of SU(3) lattice Yang-Mills theory at finite temperature.** Frenkel, J. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Marinho Junior, R.M.; Lucinda, J. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Jul 1988. 21p. Order Number DE90634547. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The phase diagram of the SU(3) four-dimensional space-time lattice Yang-Mills field theory at finite temperature is analysed by the extended mean-field technique. With this technique, finite temperature effects are present already at the saddle point approximation. A reasonable quantitative agreement with Monte Carlo numerical simulations is obtained. (author).

43564 (DOE/ER/45271–T4) **Molecular ferromagnetism: Progress report, August 1, 1989–July 30, 1990.** Epstein, A.J. Ohio State Univ. Research Foundation, Columbus, OH (USA). 5 Jun 1990. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER45271. Order Number DE90014436. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This past year has been one of substantial advancement in both the physics and chemistry of molecular and polymeric ferromagnets. The specific heat studies of (DMeFc)(TCNE) have revealed a cusp at the three-dimensional ferromagnetic transition temperature with a crossover to primarily 1-D behavior at higher temperatures. This paper discusses these studies.

43565 (DOE/ER/45280–4) **X-ray scattering studies of non-equilibrium ordering processes: Progress report, November 1, 1989–October 31, 1990.** Nagler, S.E. Florida Univ., Gainesville, FL (USA). Dept. of Physics. [1990]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER45280. Order Number DE90015066. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We report on the progress of our project entitled "X-ray Scattering of Non-Equilibrium Ordering Processes." During the past year we have made the first synchrotron measurements of ordering in Cu_3Au have revealed the presence of an intermediate, non-equilibrium ordered state. Preliminary work involving x-ray magnetic scattering has been carried out. Work is continuing in these areas as well as on related problems. 5 refs.

43566 (IFUSP-P–777) **Study of the decay kinetics of irradiation induced green color in brazilian spodumene.** Antonini, R.; Isotami, S.; Furtado, W.W.; Pontuschka, W.M.; Rabbani, S.R. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Mar 1989. 15p. Order Number DE90634538. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Numerical Runge-Kutta's method applied to a system of differential equations describing the isothermal decay kinetics of 15600 cm^{-1} band in irradiated lilac spodumene, led to the conclusions which can be summarised as follows. The untrapping parameters α_1 and α_2 obey Arrhenius law with activation energies E_1 = 0.043ev and E_2 = 1.05 ev and pre-exponential factors $\alpha_1 = 30.6s^{-1}$ and $\alpha_2 = 5.3x10^{12}s^{-1}$. The recombination parameter β and the retrapping parameters γ_1 and γ_2 were found to fit a function proportional to $(T^{1/2}-T_0^{1/2})$ with cutoff energy T_0 =346K. (author).

43567 (IFUSP-P–785) **NQR of ^{35}Cl nuclei in glassy solution of chlorobenzene in pyridine.** Wolfeson, A.E. (Universidad Nacional de Cordoba (Argentina). Facultad de Matematica Astronomia y Fisica); Brunetti, A.H.; Pusiol, D.J.; Pontuschka, W.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Jun 1989. 20p. Order Number DE90634548. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Pulsed nuclear quadrupole resonance (NQR) measurements of ^{35}Cl nuclei were performed on 43.5 mol% chlorobenzene solution in pyridine (a) in glassy state (T_g=131K) after quenching in liquid nitrogen and (b) in crystalline precipitate under slow cooling starting from liquid phase. In both cases the NQR lineshape (obtained with FFT method) consisted of a structure of two peaks, interpreted as contributions of two non-equivalent ^{35}Cl nuclei sites. A theoretical model is proposed for the lineshape analysis and the best fit parameters yield excellent agreement with experimental spectra. It is suggested that the non-equivalent sites consist of nearly parallel and anti-parallel alignement of chlorobenzene and pyridine molecules and that the line broadening mechanism is due to a random distribution of angular displacements from these positions. Our data are in agreement with Goldstein studies of molecular relaxation processes related to the changes observed on physical properties of amorphous materials at T_g. (author).

43568 (INP–1343/PS) **Proceedings of 21. winter school on physics, Zakopane, Poland, 14-20 April, 1986. Part 2: Part 2. Condensed matter studies by nuclear methods.** Krolas, K.; Hrynkiewicz, A.Z. (eds.). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1986. 275p. (CONF-8604259–: 21. winter school of physics, Zakopane (Poland), 7-11 Apr 1986). Order Number DE90634553. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

Separate abstracts were prepared for 4 papers. The remaining 11 papers were considered outside the subject scope of INIS. (M.F.W.).

43569 (INP–1343/PS, pp. 142) **New developments in nuclear level mixing resonances.** Coussement, R. (Louvain Univ. (Belgium). Inst. for Nuclear- and Radiationphysics). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1986. (CONF-8604259–: 21. winter school of physics, Zakopane (Poland), 7-11 Apr 1986). In *Proceedings of 21. winter school on physics, Zakopane, Poland, 14-20 April, 1986. Part 2: Part 2. Condensed matter studies by nuclear methods.* Order Number DE90634553. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

Published in summary form only. LEVEL MIXING RESONANCE/ solids; BISMUTH 204; BISMUTH 206; CRYSTAL DEFECTS; GERMANIUM 69; GERMANIUM 71; SOLIDS; LINE WIDTHS; M CENTERS; QUADRUPOLE MOMENTS; SILVER 109; ZINC

43570 (INP–1370/PL, pp. 423-426) **Study of the quadrupolar interaction of high spin isomers in $^{202,204,206,207}Bi$ in Tl and in $^{208,209,210,211}At$ in Bi by level mixing spectroscopy.** Hardeman, F. (Louvain Univ. (Belgium). Inst. for Nuclear- and Radiationphysics); Scheveneels, G.; Put, P.; Coussement, R. Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). 1987. (CONF-8705201–: 22. Zakopane school of physics, Zakopane (Poland), 1-8 May 1987). In *Proceedings of 22. Zakopane school on physics, Zakopane, Poland, 1-15 May 1987.*

Part 1: Selected topics in nuclear structure. Order Number DE90632511. Source: NTIS (US Sales Only), PC A20/MF A01; OSTI; INIS.

Level mixing spectroscopy was developed to determine the quadrupolar interaction of high spin isomers in metals. The method has been applied on high spin isomers in Bi and At isotopes in Tl and Bi respectively. 14 refs., 4 figs., 2 tabs. (M.F.W.).

43571 (LA-UR-90-2580) **Moessbauer Effect applications using intense radioactive ion beams.** Taylor, R.D. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9004209-4: Workshop on the science of intense radioactive ion beams, Los Alamos, NM (USA), 10-12 Apr 1990). Order Number DE90014981. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Moessbauer Effect is reviewed as a promising tool for a number of new solid state studies when used in combination with radioactive beam/implantation facilities. The usual Moessbauer Effect involves long-lived radioactive parents (days to years) that populate low-lying nuclear excited states that subsequently decay to the ground state. Resonant emission/absorption of recoil-free gamma rays from these states provide information on a number of properties of the host materials. Radioactive ion beams (RIB) produced on-line allow new Moessbauer nuclei to be studied where there is no suitable parent. The technique allows useful sources to be made having extremely low local concentrations. The ability to separate the beams in both Z and A should provide high specific activity "conventional" sources, a feature important in some applications such as Moessbauer studies in diamond anvil high pressure cells. Exotic chemistry is proposed using RIB and certain Krypton and Xenon Moessbauer isotopes.

43572 (UCRL-JC-104257) **Free-Lagrange advection slide lines.** Burton, D.E. Lawrence Livermore National Lab., CA (USA). Jun 1990. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006195-3: Free Lagrange conference, Jackson Lake, WY (USA), 3-7 Jun 1990). Order Number DE90015043. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have found the treatment of interfaces in staggered-grid hydrodynamics to be inadequate for problems with large shear deformation at material interfaces. The problem is especially evident at the intersections of multiple materials, but potentially occurs at all interfaces with large shear. To address this problem, we have introduced a two-way advection slide line algorithm into our free-Lagrange (FL) method. In addition to the interface physics itself, the algorithm involves an interface stiffener, a mesh relaxation and advection scheme suitable or unstructured meshes (FLALE), the FL mesh refinement algorithms (FLAMR), and special connectivity templates. For a slide test problem, the FL results are qualitatively similar to those of a Lagrange slide line treatment, but differ significantly in one area. At this time there is no firm basis for judging which is the correct solution. 15 refs., 11 figs.

6561 Superconductivity

Refer also to citation(s) 42938, 43556, 43557, 43558, 43559

43573 Energy productivity applications of superconductivity: Preliminary summary and highlights. Schneider, T.R. (Electric Power Research Inst., Palo Alto, CA (USA)); Dale, S.J. *Proceedings of the American Power Conference (USA)*, 51: 466-472 (1989). (CONF-890425--: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper presents an assessment of the technological opportunities for cost-effective and energy-efficient applications of new superconductors. This assessment was undertaken in order to: assess the potential technical and economic benefits of applying the HiT$_c$ superconductors to a number of energy technologies; determine system characteristics and superconductor materials parameters required for the application of the high temperature superconductors; provide DOE and EPRI with a basis for future directions in research on superconductivity.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 43572

43574 (CBPF-NF-018/89) **Birkhoff type theorem for conformally transformed metric.** Srivastava, P.P. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 9p. Order Number DE90634418. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Ricci flat solutions for conformally transformed Schwarzschild and Kasner metrics are shown to correspond to Schwarzschild and Kasner spacetimes respectively. (author).

43575 (CBPF-NF-065/88) **Geodesics in Goedel-type spacetimes.** Calvao, M.O.; Soares, I.D.; Tiomno, J. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 44p. Order Number DE90634419. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The geodesic curves of the homogeneous Goedel-type spacetimes, which constitute a two-parameter ({ l and Ω}) class of solutions presented to several theories of gravitation (general relativity, Einstein-Cartan and higher derivative) are investigated. The qualitative properties of those curves by means of the introduction of an effective potential and then accomplish the analytical integration of the equations of motion are examined. It is shown that some of the qualitative features of the free motion in Godel's universe ($l^2=2\Omega^2$) are preserved in all space-times, namely the projections of the geodesics onto the 2-surface (r,ψ) are simple closed curves, and the geodesics for which the ratio of azymuthal angular momentum to total energy, υ is equal to zero always cross the origin r = o. However, two new cases appear: (i) radially unbounded geodesics with υ assuming any (real) value, which may occur only for the causal space-times ($l^2 \geq 4\ \Omega^2$), and (ii) geodesics with υ bounded both below and above, which always occur for the circular family ($l^2 < o$) or space-times. (author).

43576 (CBPF-NF-066/88) **Test theories of special relativity: a general critique.** Maciel, A.K.A.; Tiomno, J. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 27p. Order Number DE90634420. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Absolute Spacetime Theories conceived for the purpose of testing Special Relativity (SR) are reviewed. It is found that most theories proposed were in fact SR in different coordinate systems, since in general no specific SR violations were introduced. Models based on possible SR violating mechanisms are considered. Misconceptions in recently published papers are examined. (author).

43577 (DOE/ER/25033-3) **Applied mathematics of transport theory: Final report.** Greenberg, W.; Zweifel, P.F. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Center for Transport Theory and Mathematical Physics. 1 May 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER25033. Order Number DE90014627. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This is the final report for the third year of the subject grant. We are pleased to have obtained numerous results in many areas of mathematical transport theory and of mathematical physics. We report below on what we believe to be the most significant progress on work carried on during the past year of this contract. We present these results under the headings: nonlinear kinetic equations, linear kinetic equations, specific transport models, and other areas of mathematical physics.

43578 (IFUSP-P-764) **Three-body resonance generated by a separable potential which describes a $2s_{1/2}$ single-particle state.** Ueta, K. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 13p. Order Number DE90634408. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

It is shown that a separable potential previously used to describe a $2s_{1/2}$ single-particle state gives rise not only to a bound state but also to a resonance of the core-plus-two-nucleons three-body system. (author).

43579 (JINR-R-4-89-268) **Adiabatic representation of a three-body problem in hyperspherical coordinates. Scattering amplitude.** Vinitskij, S.I. (Joint Inst. for Nuclear Research, Dubna

(USSR). Lab. of Theoretical Physics); Kadomtsev, M.B.; Suz'ko, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 28p. (In Russian). Order Number DE90634411. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Submitted to Yad. Fiz.

Adiabatic formulation is presented for a multichannel scattering problem in a system of three charged particles (a,b,c) below the three-particle disintegration threshold. The use of the hyperradius $x = \sqrt{x_a^2 + y_a^2}$ independent of the choice of reduced Jacobi vectors ($x\text{-vector}_a$, $y\text{-vector}_a$) aa,c,b, as a slow adiabatic variable, allows us to construct the invariant scattering amplitude with a long-range dipole interaction taken into account. 19 refs.; 4 figs.

43580 (LA-UR–90-2271) **Lie-Poisson bifurcations for the Maxwell-Bloch equations.** David, D. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005237–2: 10. annual conference on nonlinear science: the next decade, Los Alamos, NM (USA), 21-25 May 1990). Order Number DE90015035. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present a study of the set of Maxwell-Bloch equations on R^3 from the point of view of Hamiltonian dynamics. These equations are shown to be bi-Hamiltonian, on the one hand, and to possess several inequivalent Lie-Poisson structures, on the other hand, parametrized by the group SL(2,R). Each structure is characterized by a particular distinguished function. The level sets of this function provide two-dimensional surfaces onto which the motion takes various symplectic forms. 4 refs.

43581 (UCRL-JC–104258) **Exact conservation of energy and momentum in staggered-grid hydrodynamics with arbitrary connectivity.** Burton, D.E. Lawrence Livermore National Lab., CA (USA). Jun 1990. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006195–5: Free Lagrange conference, Jackson Lake, WY (USA), 3-7 Jun 1990). Order Number DE90015045. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For general formulations of staggered-grid hydrodynamics (SGH), we show that exact difference expressions for total energy conservation are derivable directly from the difference expressions for nodal mass and momentum conservation. The results are multidimensional and apply to arbitrarily (as well as regularly) connected grids. In SGH the spatial centering of coordinates and velocity are at nodes while mass, internal energy, and pressure are within zones; temporally, variables are usually centered at the integer time step except for velocity which is at the half step. The momentum equation is found to lead to an exactly conserved energy flux between internal energy in the zones and kinetic energy at the nodes. Exact expressions for work, kinetic and internal energy evolution, and total energy conservation follow. The derived work expression also shows that momentum, kinetic and internal energies can be exactly defined at either full or half time steps. The energy flux is not properly calculated by those SGH methods in which the work is differenced independently of the differenced momentum equation. This leads to the community observed lack of conservation in SGH methods.

43582 (UCRL-JC–104266) **Deterministic transport on an arbitrarily-connected grid.** Adams, M.L. Lawrence Livermore National Lab., CA (USA). Jun 1990. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006195–6: Free Lagrange conference, Jackson Lake, WY (USA), 3-7 Jun 1990). Order Number DE90015148. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We discuss spatial discretization of the transport equation, concentrating on the problems posed by grids with arbitrary connectivity and arbitrarily-shaped computational cells. We consider both accuracy and efficiency criteria and examine several candidate discretization schemes with respect to these criteria. We show that if arbitrarily-shaped zones are allowed, existing spatial discretization schemes do not provide the desired accuracy in the optically-thick diffusion limit. We present a new scheme that does appear to perform well in the diffusion limit, regardless of the connectivity of the grid or shape of the zones. We show that our new scheme has very nice properties in other limits as well. 8 refs., 4 figs., 1 tab.

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Refer also to citation(s) 42635, 43146, 43355, 43600, 43601, 43606, 43613, 43614, 43615

43583 (AD-A–220768/6/XAB) **Advanced concepts theory annual report 1989. Final report.** Naval Research Lab., Washington, DC (USA). 29 Mar 1990. 173p. (NRL-MR–6612). Source: NTIS, PC A08/MF A01.

This report details the work of the Radiation Hydrodynamics Branch conducted in FY 89 with respect to several critical problems concerning the design of z-pinch implosions and the optimization of their radiative output. Separate sections describe progress in the analysis of z-pinch experiments, the development of atomic, electron, plasma and MHD dynamical models to describe z-pinch implosions, and the analysis of atomic number scaling of z-pinch K-shell emission.

43584 (DOE/ET/51013–286) **Ignition and burn control characteristics of thermonuclear plasmas.** Chaniotakis, E.A. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. 20 Jun 1990. 238p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–90-11). Order Number DE90015385. Source: NTIS, PC A11/MF A01; OSTI; INIS; GPO Dep.

Achieving the long sought goal of fusion energy requires the attainment of an ignited and controlled thermonuclear plasma. Obtaining an ignited plasma in a tokamak device requires consideration of both the physics of the plasma and the engineering of the machine. With the aide of completely analytical procedure optimized and ignited tokamaks are obtained under various physics assumptions. These designs show the possible advantage of tokamaks characterized by high (~4.5) aspect ratio, and high (~15 T) toroidal magnetic field. The control of an ignited plasma is investigated by using auxiliary power modulation. With auxiliary power stable operating points can be created with Q ~50. Recognizing the need for a fast $1\frac{1}{2}$-D transport model for studying profile effects the plasma transport equations are solved using variational methods. A computer model based on the variational method has been developed. This model solves the $1\frac{1}{2}$-D transport equation very fast with little loss of accuracy. 74 refs., 70 figs., 8 tabs.

43585 (DOE/ET/53088–428) **A nonlinear bounce kinetic equation for trapped electrons.** Gang, F.Y. (Texas Univ., Austin, TX (USA). Inst. for Fusion Studies); Diamond, P.H. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Mar 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–428). Order Number DE90015002. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A nonlinear bounce averaged drift kinetic equation for trapped electrons is derived. This equation enables one to compute the nonlinear response of the trapped electron distribution function in terms of the field-line projection of a potential fluctuation $\langle e^{-in\phi} \phi_n \rangle_b$. It is useful for both analytical and computational studies of the nonlinear evolution of short wavelength ($n \gg 1$) trapped electron mode-driven turbulence. 7 refs.

43586 (DOE/ET/53088–438) **Nonlinear tearing mode; Rutherford regime and global characteristics.** Zhang, Y.Z. (Texas Univ., Austin, TX (USA). Inst. for Fusion Studies); Denton, R.; Mahajan, S.M.; Jiayu, Chen; Wootton, A. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Jun 1990. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (DOE/ER/53267–77;IFSR–438;FRCR–373). Order Number DE90015003. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Experiments on the TEXT tokamak show that the temporal evolution of a single helicity tearing mode is dominated by the Rutherford regime. Further analysis of the Mirnov signal and sawtooth activity combined with numerical simulation emphasizes the global characteristics of the tearing mode. 4 figs., 6 refs.

43587 (DOE/ET/53088–439) **Resonant MHD modes with toroidal coupling: Part 2, Ballooning-twisting modes.** Connor,

J.W. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking); Hastie, R.J.; Taylor, J.B. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies; Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Jul 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–439). Order Number DE90015185. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This is part 2 of a study of resonant perturbations, such as resistive tearing and ballooning modes, in a torus. These are described by marginal ideal mhd equations in the regions between resonant surfaces; matching across these surfaces provides the dispersion relation. In part 1 we described how all the necessary information from the ideal mhd calculations could be represented by a so-called E-matrix. We also described the calculation of this E-matrix for tearing modes (even parity in perturbed magnetic field) in a large aspect ratio torus. There the toroidal modes comprise coupled cylinder tearing modes and the E-matrix is a generalization of the familiar Δ' quantity in a cylinder. In the present paper we discuss resistive ballooning, or twisting-modes, which have odd-parity in perturbed magnetic field. We show that, unlike the tearing modes, these odd-parity modes are instrinsically toroidal and are not directly related to the odd-parity modes in a cylinder. This is evident from the analysis of the high-n limit in ballooning-space, where a transition from a stable Δ' to an unstable Δ' occurs for the twisting mode when the ballooning effect exceeds the interchange effect, which can occur even at large aspect ratio (as in a tokamak). Analysis of the high-n limit in coordinate space, rather than ballooning space, clarifies this singular behaviour and indicates how one may define twisting-mode Δ'. It also yields a prescription for treating low-n twisting modes and a method for calculating an E-matrix for resistive ballooning modes in a large aspect ratio tokamak. The elements of this matrix are given in terms of cylindrical tearing mode solutions.

43588 (INIS-mf–12629) **Passive control of vertical instabilities in ITER: ITER documentation series.** Yamane, M. (Mitsubishi Fusion Center. Tokyo (Japan)); Coccorese, E.; Sugihara, M. International Atomic Energy Agency, Vienna (Austria). Sep 1989. 23p. Order Number DE90706120. Source: NTIS (US Sales Only), PC A03/MF A01.

The paper presents the results of the scoping studies carried out for ITWE during the spring/summer 1988 in the field of the vertical stabilization of plasma. After a brief introduction, the calculational results based on two different models are presented and commented; then, the conclusions drawn are presented to show how the vertical stabilization problem may impose limitations and/or requirements both on physical parameters (primarily the plasma elongation) and on technological solutions for the first wall/blanket (primarily the number of torus sectors) of ITER. Main results and conclusions of this scoping study have been summarized and included in the respective chapters of the ITER Concept Definition Report. (author). 3 refs., 9 figs., 2 tabs.

43589 (INIS-mf–12630) **Design point selection for an ignited ITER: ITER documentaiton series.** Spears, W.R. (Max-Planck-Inst. fuer Plasmaphysik, Garching (Germany, F.R.). International Thermonuclear Experimental Reactor (ITER)); Mizoguchi, T.; Perkins, J.; Putvinskij, S.; Flanagan, C. International Atomic Energy Agency, Vienna (Austria). Sep 1989. 30p. Order Number DE90706122. Source: NTIS (US Sales Only), PC A03/MF A01.

The parameter choice for the ITER design is dominated by the need to achieve ignition. Different energy confinement time scalings extrapolate to different device parameters, and the final design chosen must have a reasonable change of success under the presently favoured scalings. This study investigates the device performance over the plasma current - aspect ratio design space, using sets of simplified equations and more detailed parametric analysis codes, with a view to clarifying the acceptable parameter region. Alterations to the initial assumptions of plasma elongation, plasma safety factor and peak toroidal field, and the effect of limiting the wall load, are also investigated. The study concludes that a device with aspect ratio around 3 and plasma current about 20 MA would be an appropriate choice. Under the assumptions of the study such a device would have a major radius of about 5.8m and would require the attainment of enhancement factors around 1.5 over L-mode scaling. (author). 6 refs., 11 figs., 3 tabs.

43590 (INPE–4938) **Experimental study on negative hydrogen ion formation in the quiescent plasma machine at INPE.** Ferreira, J.L.; Ferreira, J.G.; Damasio, W.C. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). 31 Jul 1989. 6p. (In Portuguese). Order Number DE90634635. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The preliminary results from the study on generation of positive and negative hydrogen ions in plasma produced by thermionic discharge confined superficially by magnetic fields, are presented. In the interior of this discharge was inserted a Langmuir electrostatic probe to measure H^-, H^+, H^+_2 and H^+_3 concentrations in the plasma produced from argon (Ar) and hydrogen (H_2) gas mixture. (M.C.K.).

43591 (INPE–4953) **Construction and calibration of high time resolution gas pressure meter.** Rossi, J.O.; Santos, C.; Ueda, M. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Nov 1989. 33p. (In Portuguese). Order Number DE90634598. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In this report, the construction and calibration of a gas pressure meter with a time resolution better than 20 μs are described. The meter consists basically of a sensor of the FIG (Fast Ionization Gauge) type and an adequate electronic circuit. A 6AU6A pentode vacuum tube without the glass envelope is used as the sensor head. (author).

43592 (Juel–2269) **Development of a process of measurement for the partial pressure determination of helium in the presence of deuterium and its application to the examination of guidance values on the TEXTOR pump limiter ALT-I.** Hardtke, A. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Plasmaphysik; Essen Univ. (Gesamthochschule) (Germany, F.R.). Mar 1989. 115p. (In German). Order Number DE90512895. Source: NTIS (US Sales Only), PC A06/MF A01.

The pump limiter concepts are described as the introduction. The interaction of the neutral gas flowing back with the incoming plasma particles in the incoming duct of a pump limiter is examined. Due to the simultaneous presence of deuterium molecules, the determination of the pumped out proportion of helium gas causes difficulties because of the near equality of the masses of helium 4 and deuterium molecules. The process of measurement developed makes simultaneous measurement of helium and deuterium partial pressures possible. Using this process, in the second part of the work, the flow-back guide value for helium on the ALT-I pump limiter of TEXTOR is examined in different plasma conditions and is compared with the flow-back guide value for H_2 and D_2. (GG).

43593 (ORNL/TM–11523) **Formation of magnetic islands due to field perturbations in toroidal stellarator configurations.** Lee, D.K.; Harris, J.H.; Lee, G.S. Oak Ridge National Lab., TN (USA). Jun 1990. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014789. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An explicit formulation is developed to determine the width of a magnetic island separatrix generated by magnetic field perturbations in a general toroidal stellarator geometry. A conventional method is employed to recast the analysis in a magnetic flux coordinate system without using any simplifying approximations. The island width is seen to be proportional to the square root of the Fourier harmonic of B^ρ/B^ζ that is in resonance with the rational value of the rotational transform, where B^ρ and B^ζ are contravariant normal and toroidal components of the perturbed magnetic field, respectively. The procedure, which is based on a representation of three-dimensional flux surfaces by double Fourier series, allows rapid and fairly accurate calculation of the island widths in real vacuum field configurations, without the need to follow field lines through numerical integration of the field line equations. Numerical results of the island width obtained in the flux coordinate representation for the Advanced Toroidal Facility agree closely with those determined from Poincare puncture points obtained by following field lines. 22 refs., 5 tabs.

43594 (PPPL–2694) **Transport simulations of TFTR experiments to test theoretical models for χ_e and χ_i.** Redi, M.H.; Bateman, G. Princeton Univ., NJ (USA). Plasma Physics Lab. Aug 1990. 49p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90014810. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

1-$\frac{1}{2}$-d BALDUR transport code predictions using recent theoretically-based models for thermal and particle transport are compared to measured profiles of electron plasma density and electron and ion temperatures for TFTR ohmic, L-mode and supershot discharges. The profile consistent drift wave model is found to overestimate ion temperatures at high heating powers, so that a third mode or loss process is needed in addition to drift wave transport (TEM, η_i) and an edge loss model. None of several versions of local multiple mode models, using the 1989 Carreras-Diamond resistive ballooning model, gives T_e, T_i within 20% for all three TFTR regimes studied. 36 refs., 7 figs., 4 tabs.

43595 (PPPL–2712) **Dielectronic satellite spectra of hydrogenlike iron from TFTR [Tokamak Fusion Test Reactor].** Decaux, V. (Institut du Radium, 75 - Paris (France)); Bitter, M.; Hsuan, H.; von Goeler, S.; Hill, K.W.; Hulse, R.A.; Taylor, G.; Park, H.; Bhalla, C.P. Princeton Univ., NJ (USA). Plasma Physics Lab. Aug 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90014753. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Spectra of hydrogenlike iron, Fe26, have been observed from Tokamak Fusion Test Reactor (TFTR) plasmas with a high-resolution crystal spectrometer. The experimental arrangement permits simultaneous observation of the Fe26 Ly-α_1 and Ly-α_2 lines and the associated dielectronic satellites, which are due to transitions 1snl-2pnl′ with $n \geq 2$, as well as the heliumlike $1s^2(^1S_0)-1s4p(^1P_1)$ and both hydrogenlike Ly-β_1 and Ly-β_2 lines from chromium. Relative wavelengths and line intensities can be determined very accurately. The spectral data are in very good agreement with theoretical calculations. The observed spectra have also been used to estimate the total dielectronic recombination rate coefficient of Fe26. 30 refs., 4 figs., 3 tabs.

43596 **Physics of ionized gases.** 406p. Nova Science Publishers, Inc., Commack, NY (USA) (1986). (CONF-860993–: SPIG '86: international symposium and summer school on the physics of ionized gases, Sibenik (Yugoslavia), 1-5 Sep 1986).

This book contains the proceedings of a conference on the physics of ionized gases. Topic covered include: Atomic spectra and interaction with photons; Magneto-optical and electro-optical spectra; Spectral line shapes and intensities; and Solar Physics and plasma physics.

43597 **Laser induced plasmas in alkali metal vapors.** Bahns, J.T. (Univ. of Iowa, Center for Laser Science and Engineering and Dept. of Chemistry and Physics, Iowa City, IA (US)); Koch, M.; Stwalley, W.C. pp. 503-516 of The physics of ionized gases. Tanovic, L.; Konjevic, N.; Tanovic, N. Nova Science Publishers, Inc., Commack, NY (USA) (1989). (CONF-880831–: 14. summer school and international symposium on the physics of ionized gases, Sarajevo (Yugoslavia), 15-19 Aug 1988).

Laser irradiation of alkali vapors at the atomic resonance line (e.g. Na 3s → 3p) can produce ionization and breakdown at powers far lower than are needed for breakdown of gases of higher ionization potential. Long pulsed (or CW) resonance laser radiation can produce breakdown in alkali metal vapors even at modest power (millijoules/pulse or mW). It has been shown that 500 ns, 300 mj pulses (at the 3s → 3p resonance transition in Na) can fully ionize a column of Na ($\sim 10^{16}$ cm^{-3}). This process has also been observed in other alkalis and alkaline earth metals using long pulse length, high power lasers. The authors consider other techniques for producing, characterizing (e.g. spectroscopically) and understanding laser induced plasmas such as quasiresonant laser-induced plasmas (e.g. NA 3p → 4d), and two-photon resonant laser-induced plasmas (e.g. Na 3s → 4d).

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Refer also to citation(s) 42956, 43140, 43146, 43593, 43632

43598 (DOE/DP/40200–124) **LLE [Laboratory for Laser Energetics] review: Quarterly report, January–March 1990: Volume 42.** Bradley, D.K. (ed.). Rochester Univ., NY (USA). Lab. for Laser Energetics. [1990]. 72p. Sponsored by U.S. DOE Defense Programs. DOE Contract FC03-85DP40200. Order Number DE90014666. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This volume of the LLE Review, covering the period January–March 1990, contains a study of electron heat transport using two-dimensional Fokker-Planck simulations and an article describing how plastic microshells are being manufactured at LLE for future implosion studies. The advanced technology section reports on an experiment that has measured exponential gain in a number of x-ray lasing transitions and discusses the continuing development of a two-dimensional high-speed electro-optic probing system. Finally, the activities of the National Laser Users Facility and the GDL and OMEGA laser facilities are summarized.

43599 (INIS-mf–12627) **ITER concept definition series. V.2: ITER documentation series.** International Atomic Energy Agency, Vienna (Austria). Jul 1989. 24p. Order Number DE90706119. Source: NTIS (US Sales Only), PC A03/MF A01.

The International Thermonuclear Experimental Reactor (ITER) is envisioned as a fusion device which would demonstrate the scientific and technological feasibility of fusion power. As a first step towards achieving this goal, the European Community, Japan, the Soviet Union, and the United States of America have entered into joint conceptual design activities under the auspices of the International Atomic Energy Agency. A brief summary of the Definition Phase of ITER activities is contained in this report. Included in this report are the background, objectives, organization, definition phase activities, and research and development plan of this endeavor in international scientific collaboration. A more extended technical summary is contained in the two-volume report, "ITER Concept Definition," IAEA/ITER/DS/3. 2 figs., 2 tabs.

43600 (INIS-mf–12628/V.1) **ITER concept definition. V.1: ITER documentation series.** International Atomic Energy Agency, Vienna (Austria). Jul 1989. 71p. Order Number DE90706123. Source: NTIS (US Sales Only), PC A04/MF A01.

Under the auspices of the International Atomic Energy Agency (IAEA), an agreement among the four parties representing the world's major fusion programs resulted in a program for conceptual design of the next logical step in the fusion program resulted in a program for conceptual design of the next logical step in the fusion program, the International Thermonuclear Experimental Reactor (ITER). The definition phase, which ended in November, 1989, is summarized in two reports: a brief summary is contained in the ITER Definition Phase Report (IAEA/ITER/DS/2); the extended technical summary and technical details of this report contains the Introduction and Summary, and the remainder will appear in Volume 2. In the Conceptual Design Activities phase, ITER has been defined as being a tokamak device. The basic performance parameters of ITER are given in Volume 1 of this report. In addition, the rationale for selection of this concept, the performance flexibility, technical issues, operations, safety, reliability, cost, and research and development needed to proceed with the design are discussed. Figs and tabs.

43601 (INIS-mf–12628/V.2) **ITER concept definition. V.2: ITER documentation series.** International Atomic Energy Agency, Vienna (Austria). Sep 1989. 562p. Order Number DE90706121. Source: NTIS (US Sales Only), PC A24/MF A01.

Volume II of the two volumes describing the concept definition of the International Thermonuclear Experimental Reactor deals with the ITER tokamak. Included are an assessment of the current database for design, scoping studies, rationale for concepts selection, performance flexibility, the ITER concept, the operations and experimental/testing program, ITER parameters and design phase schedule, and research and development specific and design phase schedule, and research and development specific to ITER. This latter includes a definition of specific research and development tasks, a division of tasks among members, specific milestones, required results, and schedules. figs and tabs.

43602 (INT–218/P) **Time distributions of muon catalyzed fusion events in deuterium calculated using the existing theoretical predictions.** Warszynski, P.; Czaplinski, W.; Gula, A. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1987. 23p. Order Number DE90634653. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Time distributions of muon-catalyzed fusion events in deuterium are calculated in the temperature range T=35 - 1000 K using the recent predictions for the μCF parameters. The kinetic graph taken into consideration includes spin structure of $d\mu$ and $dd\mu$ together with the corresponding hyperfine and back decay transitions. Comparison of the calculated curves with the experimental data at T=35 K and 300 K is presented. In general, the data suggest the resonant rates which are smaller than recently calculated. An attempt is made to fit the data using the resonance and back decay rates rescaled by a common factor. The fits show that the rates should be reduced at least by a factor of about three. However, this assumption is not sufficient for a consistent description of the time distributions at both temperatures and more data are needed to resolve the existing ambiguity. The corresponding curves are calculated also for other temperatures. 29 refs., 6 figs. (author).

43603 (LA-UR–90-2236) **Progress on the momentum-rich ion beam concept for ICF.** Wilson, D.C. (Los Alamos National Lab., NM (USA)); Maschke, A.W. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007111–11: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90015102. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the momentum rich beam (MRB) approach to inertial confinement fusion, ions from a low emittance source are electrostatically accelerated to 30–1000 keV, neutralized, and then propagate first collisionlessly then, at a few cm radius, collisionally to target. Encouraging experimental and theoretical results have changed the MRB approach to inertial fusion since the last report. Measurements on a cesium ion source show extremely low divergence beams with transverse beam temperature of only 0.1eV, the source thermal temperature. Neutralization adds very little divergence to beam. Using collimated argon and xenon plasma sources accelerated to 50keV, we found the rms resonant scattering angle proportional to $\sqrt{I/m_i}$. The scattering angle is halved by neutralizing an argon beam with cesium, rather than argon gas. During the collisionless collapse a precursor is formed which can implode the target more adiabatically. Calculations of the collisional collapse show 3/4 or more of the beam thermal energy will be radiated away. Since this energy arose from the compression of initial transverse velocities, higher emittance ion sources can be used. Targets containing DT calculate to ignite and achieve moderate gain (20) with beam energies below 1MJ. DD targets also calculate to burn at similar beam energies, avoiding the need for tritium breeding in a reactor. 3 refs., 2 figs.

43604 (LA-UR–90-2445) **Beam rotation and shear in a large electron beam diode.** Mansfield, C.R.; Oona, H.; Shurter, R.P. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9009192–3: International symposium on discharges and electrical insulation in vacuum, Santa Fe, NM (USA), 17-20 Sep 1990). Order Number DE90014902. Source: NTIS, PC A02/MF A01 - OSTI.

The time averaged electron beam current distribution of one of the electron guns of the Large Aperture Module (LAM) of the Aurora laser was measured as part of a larger set of experiments designed to study the electron beam transport to and energy deposition in the LAM laser chamber. The LAM laser chamber has a 1-m x 1-m aperture and is pumped from two sides along a 2-m length. A 10 ga. stainless steel sheet was placed inside the laser chamber and served multiple purposes. First, it was used to convert high energy electrons into X-rays in order to make radiograms of the electron beam. Second, the sheet was used as a Faraday cup to measure the total beam current. Third, individual Faraday cups were mounted on the plate to sample the time history of the electron beam at various positions. Each of the LAM electron gun diodes produces a beam of 750 kV electrons with a total current of about 500 kA which is relatively uniform over the cathode area of 1 m x 2 m. An applied magnetic field of about 1300 Gauss is used to prevent pinch of the beam during beam transport.

43605 (ORNL/TM–11480) **The superfluid diffusion equation $S(T)(\partial T/\partial t) = \nabla\cdot[K(T)(\nabla T)^{1/3}]$.** Dresner, L. Oak Ridge National Lab., TN (USA). Jun 1990. 77p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014788. Source: NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This report deals with the superfluid diffusion equation, $S(T)(\partial T/\partial t) = \nabla\cdot[K(T)(\nabla T)^{1/3}]$, which describes heat transport in turbulent helium-II (superfluid helium). Three methods of solution – the method of similarity, the variational method, and the method of maximum/minimum principles – are applied to this equation. The solutions discovered are helpful in addressing the use of helium-II in superconducting magnets and other applications. 22 refs., 23 figs., 3 tabs.

43606 (ORNL/TM–11558) **Stellarator status, 1989.** Lyon, J.F. (Oak Ridge National Lab., TN (USA)); Grieger, G.; Rau, F.; Iiyoshi, A.; Navarro, A.P.; Kovrizhnykh, L.M.; Pavlichenko, O.S. Oak Ridge National Lab., TN (USA). Jul 1990. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014791. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The present status of stellarator experiments and recent progress in stellarator research (both experimental and theoretical) are reported by groups in the United States, the USSR, Japan, Australia, and the European Community (the Federal Republic of Germany and Spain). Experiments under construction and studies of large, next-generation stellarators are also described. 73 refs., 11 figs., 4 tabs.

43607 (SAND–89-2907C) **Ion divergence and the stability of magnetically insulated diodes.** Slutz, S.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–10: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90014565. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Cold fluid equilibria for magnetically insulated ion diodes are unstable. The interaction of these unstable waves with electrons leads to loss above a threshold wave amplitude. The waves also interact with ions producing both divergence and energy spread. The magnitude of these effects depends strongly on the diode equilibrium and the wave parameters. Since, previous stability analyses ignored the virtual cathode and the charge-neutral region, both important features of Applied-B ion diode equilibria, we have investigated diode stability with these features included. The nature of ion diode instability is changed dramatically. Ultimately one would like to control ion divergence and energy spread, which depend on the wave amplitudes. We present test particle calculations of wave-electron interactions within the diode. Comparison of our results with 3-D PIC simulations, indicate that wave amplitudes late in the simulations are just large enough to produce electron loss. This suggests that a reduction in ion divergence might result from decreasing the wave amplitude required to induce electron loss. This and other possible approaches for reducing ion divergence are discussed. 12 refs., 4 figs., 1 tab.

43608 (SAND–90-1591C) **Theory of applied-B ion diodes.** Quintenz, J.P.; Desjarlais, M.P.; Krall, N.A.; Mehlhorn, T.A.; Mendel, C.W. Jr.; Olson, C.L.; Pointon, T.D.; Rosenthal, S.E.; Seidel, D.B.; Slutz, S.A.; Bailey, J.E.; Coats, R.S.; Cook, D.L.; Johnson, D.J.; Kiefer, M.L.; Leeper, R.J.; Lockner, T.R.; Maench-Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–12: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90015139. Source: NTIS, PC A03/MF A01 - OSTI.

Progress in the development of the theory of applied-B ion diodes has been rapid since the BEAMS '88 meeting. This paper describes recent advances in the analytic theory and numerical simulation of applied-B ion diodes in general and, in particular, the diodes being tested experimentally on PBFA-2 at Sandia National Laboratories. 50 refs., 6 figs.

43609 (SAND–90-1805C) **PBFA 2 applied B ion diode beam characteristics at high voltages.** Johnson, D.J.; Lockner, T.R.; Coats, R.S.; Mehlhorn, T.A.; Nelson, W.E.; Chandler, G.A.; Desjarlais, M.P.; Derzon, M.S.; Leeper, R.J.; Maenchen, J.E.; Mattson, C.R.; Pregenzer, A.L.; Rosenthal, S.E.; Ruiz, C.L.; Stinnett, R.W.; Stygar, W.A.; Wenger, D.F. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009192–4: International symposium on discharges and electrical insulation in vacuum, Santa Fe, NM (USA), 17-20 Sep 1990). Order Number DE90014419. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An applied B-field ion diode has been operated at 21 TW on PBFA 2 to study beam generation and transport physics. The radial focusing 15-cm-radius diode utilized a pair of magnet coils in disc cathode structures to produce an axial B-field to minimize electron loss in the 16 mm anode-cathode gaps. The diode was different than used in the past with the cathodes 20% closer together and the B-field increased to 3.3 T at the midplane. The 2.5 MA beam originated from a 5-cm-tall ion emitting region and was transported toward the axis in a 12.5-cm-radius gas cell with 2-μm-thick mylar window and a 5-Torr-argon gas fill. A surface flash-over plasma created by electron loss on wax-filled grooves in the anode produced a beam with comparable currents of proton and carbon ions. The experimental results include the spatial uniformity and time dependence of proton and carbon beam emission from the anode and the divergence and focusability of both beams. 10 refs., 13 figs.

43610 (SAND–90-1922C) **Development of the BOLVAPS-LIBORS [Boil-Off Lithium VAPor Source-Laser Ionization Based On Resonance Saturation] lithium ion source for the PBFA-2 [Particle Beam Fusion Accelerator-2] accelerator.** Dreike, P.L.; Appel, D.B.; Cuneo, M.E.; Grasser, T.; Lamppa, K.P.; Moore, R.H.; Peeples, C.R.; Renk, T.J.; Tisone, G.C. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009192–6: International symposium on discharges and electrical insulation in vacuum, Santa Fe, NM (USA), 17-20 Sep 1990). Order Number DE90014999. Source: NTIS, PC A02/MF A01 - OSTI.

A large area surface source of Lithium plasma for use as an ion source in the PBFA-2 ion beam diode is described. BOLVAPS produces a 1–2 mm thick layer of Li vapor with a density approaching 1×10^{17} cm^{-3} by rapid ohmic heating of a thin film laminate, one layer of which contains Li. The principal design issues of the vapor source being built for use on the PBFA-2 accelerator are described. LIBORS uses 670.8 nm laser light to efficiently ionize the Li vapor. The results of small-scale Physics tests and full-scale component development are summarized. 13 refs., 6 figs.

43611 (SAND–90-1923C) **Characterization of electron flow in positive-polarity linear-induction accelerators.** Rosenthal, S.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009192–5: International symposium on discharges and electrical insulation in vacuum, Santa Fe, NM (USA), 17-20 Sep 1990). Order Number DE90014998. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experiments at Sandia National Laboratories have studied the operation of the linear-induction accelerators, HELIA and Hermes 3, in positive polarity. These experiments have provided a unique opportunity to explore the consequences of multiple-cathode electron emission in magnetically insulated transmission lines. An examination of the total energy-canonical momentum distribution of the electrons explains the features of the magnetically insulated flow exhibited by these systems. Simple analysis based on the basic concept of pressure balance, in conjunction with particle-in-cell numerical simulations, shows how the line voltage is related to the anode and cathode currents. Two flow designations are introduced that can apply to multiple-cathode magnetically insulated transmission lines: full-gap flow (FGF), and locally emitted flow (LEF). 16 refs., 15 figs.

43612 (UCRL-JC–103616) **Modeling conversion efficiency experiments in gold beryllium disks.** Langer, S.H.; Kania, D.R.; Kauffman, R.L.; Kornblum, H.N.; Ze, F. Lawrence Livermore National Lab., CA (USA). [1990]. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900748–1: 20. anomalous absorption conference, Traverse City, MI (USA), 9-13 Jul 1990). Order Number DE90015145. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of disks, varying from pure beryllium to pure gold, has been illuminated by 1 ns flat topped pulses of 3ω light at intensities of $\approx 5 \times 10^{14}$ W/cm^2 on the NOVA laser. This paper compares LASNEX models to the experimental data. Time integrated M-band spectra have been measured from both the front and back sides of a disk on a single shot. This data provides a probe of the emission in the hot ablated plasma and the absorption in the cold unablated plasma, and thus provides a check on LASNEX's ability to calculate emission and absorption in two different regimes. The optical depth of the slab varies as a function of the gold concentration, so this data also provides a check on the radiation transport modeling in LASNEX. The time dependence of the x-rays from the slab was measured in several spectral bands. Default LASNEX models predict that the x-ray intensity should closely track the laser intensity, while the data shows the x-ray intensity increasing much more slowly than the laser intensity. We present models that attempt to explain this effect. We conclude with a summary of the areas in which the models are in good agreement with the data, speculate about the cause of discrepancies in other areas, suggest future experiments, and indicate how our results relate to ICF experiments. 3 refs., 10 figs.

43613 Construction and initial operation of the Advanced Toroidal Facility. Lyon, J.F. (Oak Ridge National Lab., TN (USA)); Bigelow, T.S.; Colchin, R.J.; Crume, E.C.; Dunlop, J.L.; England, A.C.; Glowienka, J.C.; Goulding, R.H.; Harris, J.H.; Hills, D.L.; Hiroe, S.; Horton, L.D.; Howe, H.C.; Isler, R.C.; Jernigan, T.C.; Langley, R. *Fusion Technology (USA)*, 17(1): 33-50 (Jan 1990). DOE Contract AC05-84OR21400.

The Advanced Toroidal Facility (ATF) torsatron was designed on a physics basis for access to the second stability regime and on an engineering basis for independent fabrication of high-accuracy components. The actual construction, assembly, and initial operation of ATF are compared with the characteristics expected during the design phase.

43614 Near-term directions in the World Stellarator Program. Lyon, J.F. (Oak Ridge National Lab., TN (USA)). *Fusion Technology (USA)*, 17(1): 19-32 (Jan 1990). DOE Contract AC05-84OR21400.

Interest in stellarators has increased because of the progress being made in the development of this concept and the inherent advantages of stellarators as candidates for an attractive, steady-state fusion reactor. Three new stellarator experiments started operation in 1988, and three more are scheduled to start in the next few years. In addition, design studies have started on large next-generation stellarator experiments for the mid-1990s. These devices are designed to test four basic approaches to stellarator configuration optimization. Ways in which these devices complement each other in exploring the potential of the stellarator concept and the main issues that they will address during the next decade are described.

43615 Advanced Toroidal Facility II studies. Lyon, J.F. (Oak Ridge National Lab., TN (USA)); Carreras, B.A.; Dominguez, N.; Dresner, L.; Hedrick, C.L.; Hirshman, S.P.; Lubell, M.S.; Lue, J.W.; Painter, S.L.; Rome, J.A.; Morris, R.N.; van Rij, W.I. *Fusion Technology (USA)*, 17(1): 188-205 (Jan 1990). DOE Contract AC05-84OR21400.

Design studies for a low-aspect-ratio, large next-generation stellarator, Advanced Toroidal Facility II (ATF-II), with high-current-density, high-field, stable NbTi/Cu helical windings are described. The design parameters are an average plasma radius of 0.52 m, a major radius of 2 m, and a field on axis of 4 to 5 T, with 10 to 15 MW of heating power. Such a device would be comparable in cope to other next-generation stellarators but would have roughly the same aspect ratio as the tokamaks without, however, the need for current drive to sustain steady-state operation. A number of low-aspect-ratio physics issues need to be addressed in the design of ATF-II, primarily compromises between high-beta capability and good confinement properties. A six-field-period compact torsatron is chosen as a reference design for ATF-II, and its main features

and performance predictions are discussed. An integrated (beta capability and confinement) optimization approach and optimization of superconducting windings are also discussed.

43616 Japanese magnetic confinement fusion research. Davidson, R.C.; Abdou, M.A.; Berry, L.A.; Horton, C.W.; Lyon, J.F.; Rutherford, P.H. Foreign Applied Sciences Assessment Center, La Jolla, CA (USA). Jan 1990. 334p. Source: NTIS, PC A15/MF A02.

Six U.S. scientists surveyed and assessed Japanese research and development in magnetic fusion. The technical accomplishments from the early 1980s through June 1989 are reviewed, and the Japanese capabilities and outlook for future contributions are assessed. Detailed evaluations are provided in the areas of basic and applied plasma physics, tokamak confinement, alternate confinement approaches, plasma technology, and fusion nuclear technology and materials.

99 GENERAL AND MISCELLANEOUS

9901 Management

Refer also to citation(s) 42612, 42778, 42850, 42857, 43121, 43234, 43236, 43649

43617 (DOE–76-45/38) **Safety considerations for security programs.** Briscoe, G.J.; Nertney, R.J.; Riffe, D.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1987. 80p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC07-76ID01570. (SSDC–38). Order Number DE90014197. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report discusses safety considerations related to security programs. It deals with the safety/security relationship in three parts: theory of risk management and loss control as applied to security programs; actuarial analysis and its interpretation of performance data in the security/safety area; and an appendix discussing actuarial analysis using a personal computer, Lotus 1-2-3. While this report is focused on security activities, it also provides a general model for similar applications in other areas. The risk management approach described herein may be applied to safety analysis of any activity. 9 refs., 13 figs., 12 tabs.

43618 (DOE–76-45/39) **Process operational readiness and operational readiness follow-on.** Nertney, R.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). System Safety Development Center. Feb 1987. 76p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC07-76ID01570. (SSDC–39). Order Number DE90014196. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The first document in the SSDC (System Safety Development Center) series deals with the subject of Occupancy-Use Readiness. The material included in that manual provided the basis for development of the SSDC workshop in Operational Readiness. The original Occupancy-Use Readiness Manual, however, deals only generally with the subject of process safety; i.e., the safety of overall "processes" such as solar collection systems, nuclear reactors, and coal fired electrical plants. The manual also fails to detail the considerations involved in maintaining the state of readiness on a continuing basis. Both of the latter subjects are dealt with in some detail in the SSDC's Operational Readiness Workshop. The purpose of this document is to provide additional documentary material dealing with subjects introduced in SSDC-1, Occupancy-Use Readiness Manual, and SSDC-12, Safety Considerations in Evaluation of Maintenance Programs. In augmenting SSDC-1, Part 1 of this manual provides additional material related to process safety; in the case of SSDC-12, the subject of safety considerations in evaluation of maintenance programs is broadened in Part 2 to include maintenance of personnel systems and procedural systems as well as hardware. "Maintenance" is related more directly to the concept of operational readiness and an alternative analytical tree is provided for hardware maintenance program evaluation. 7 refs., 19 figs.

43619 (DOE–76-45/40) **The assessment of behavioral climate.** Gertman, D.I.; Haney, L.N.; Blackman, H.S.; Schurman, D.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). System Safety Development Center. Jan 1988. 25p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC07-76ID01570. (SSDC–40). Order Number DE90014200. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document provides guidelines for the evaluation of factors that affect the human performance component of systems performance. Behavioral climate may be used to assess elements in the workplace that effect human performance. An analytical tree is included as a structure to aid in this human performance evaluation. This study is not meant to be exhaustive. Certainly, there are other valid approaches to the assessment of key organizational and performance factors. The evaluation begins by appraising the congruence of company objectives, goals, and policies at all levels of organizational structure. Related to this is the determination is to whether management practices match the characteristics of the organization. Next, the evaluation method is used to determine whether the characteristics of the people doing the work match the characteristics of the job. This determination includes such things as physical, knowledge/skill, and psychological characteristics of the people involved. Following this step, the rewards for doing the work within the organization are identified and then are evaluated in terms of their congruence with employee performance expectations. A method for determining relevant differences is presented. The last major area of this System Development Center (SSDC) evaluation method address whether the psychological and physical needs of personnel are met in the work environment. 8 figs.

43620 (DOE–76-45/41) **Investigating and reporting accidents effectively.** Fillmore, D.; Trost, A. EG and G Idaho, Inc., Idaho Falls, ID (USA). System Safety Development Center. [1990]. 21p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC07-76ID01570. (SSDC–41). Order Number DE90014199. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This booklet is written to help the untrained accident investigator perform a type "C" accident investigation. It is designed to identify the philosophy of accident investigation, the steps involved, the potential problems in the investigation, and give instruction for completing the DOE 5484.X form. A hypothetical accident is analyzed to illustrate the proper investigating and reporting techniques.

43621 (IAEA-TECDOC–550, pp. 55-59) **Special invited presentation.** Bernthal, F.M. (United States Dept. of State, Washington, DC (USA). Bureau of Oceans and International Environmental and Scientific Affairs). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Some general aspects concerning the nature of global climatic change and potential response strategies for addressing such change are discussed.

43622 (IAEA-TECDOC–550, pp. 61-64) **Acidification and the greenhouse effect: A Canadian perspective.** Malinauskas, A.J. (Atmospheric Environment Service, Downsview, ON (Canada)). International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (USA). Apr 1990. (CONF-890841–: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). In *Safety of nuclear installations: Future direction: Proceedings of an international workshop on the safety of nuclear installations of the next generation and beyond, sponsored by the IAEA and the Government of the United States of America through Argonne National Laboratory and held in Chicago, 28-31 August 1989.* Order Number DE90635307. Source: NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS.

Climate change is a priority issue for the Canadian Government. The Canadian approach is to develop a comprehensive international response with full utilization and strengthening of the existing

network of international institutions and OECD/IEA Energy-Environment initiatives.

9902 Mathematics and Computers

Refer also to citation(s) 42365, 42584, 42607, 42608, 42610, 42611, 42633, 42635, 42651, 42652, 42705, 42706, 42707, 42741, 42776, 42777, 42796, 42800, 42805, 42821, 42878, 42891, 42910, 42937, 42957, 43053, 43116, 43119, 43131, 43134, 43208, 43216, 43224, 43225, 43226, 43243, 43290, 43304, 43308, 43319, 43343, 43431, 43548, 43572, 43577, 43580, 43582, 43605, 43612, 43649

43623 (ANL/MCS-TM-138) **ELEFUNT test results under AST Fortran V1.8.0 on the Sequent Symmetry.** Cody, W.J. Argonne National Lab., IL (USA). Mathematics and Computer Science Div. Jul 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE90014932. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report discusses testing of the floating-point arithmetic and of the elementary function libraries under AST Fortran on a 24-processor Sequent Symmetry computer. The programs MACHAR and PARANOIA were used to check the quality of arithmetic, and the ELEFUNT suite of programs from the book Software Manual for the Elementary Functions by Cody and Waite was used to check function performance. Two complete sets of tests were run, one for each type of floating-point processor, Intel 80387 and Weitek 1167, on the machine. 11 refs., 4 tabs.

43624 (CONF-9006248-1) **Prediction, control, and decision-making aspects for chaotic systems.** Protopopescu, V. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 8. international congress on cybernetics and systems; New York, NY (USA); 11-15 Jun 1990. Order Number DE90014452. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Several examples of chaotic systems are discussed for which occurrence of chaos, information recovery, control, and decision-making processes appear in a new, sometimes counterintuitive light. From case to case, explanations, conjectures, and/or possible applications are indicated. 14 refs.

43625 (KFKI-1989-62/M, pp. 1-28) **On some algorithms for computer evaluation of functional integrals.** Lobanov, Yu.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR)); Zeinalova, O.V.; Zhidkov, E.P.; Shakhbagian, R.R. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Nov 1989. In *Collection of scientific papers in collaboration with Joint Institute for Nuclear Research, Dubna, USSR and Central Research Institute for Physics, Budapest, Hungary Vol. 6: Algorithms and programs for solution of some problems in physics.* Order Number DE90634391. Source: NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS.

The construction of approximation formulas for the functional integrals with respect to a Gaussian measure in the full separable metric spaces is described. In the special case of conditional Wiener measure the family of approximation formulas with weight is obtained. The employment of the formulas gives significant (by an order) economy of computer time and memory versus lattice Monte Carlo method. The functional integration measure in Euclidean quantum field theory with polynomial interactions of boson fields in two-dimensional space-time is investigated. (author) 53 refs.; 10 tabs.

43626 (LA-UR-90-2260) **Computer security plan development using an expert system.** Hunteman, W.J. (Los Alamos National Lab., NM (USA)); Evans, R.; Brownstein, M.; Chapman, L. Los Alamos National Lab., NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106-53: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90015087. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Computer Security Plan Assistant (SPA) is an expert system for reviewing Department of Energy (DOE) Automated Data Processing (ADP) Security Plans. DOE computer security policies require ADP security plans to be periodically reviewed and updated by all DOE sites. SPA is written in XI-Plus, an expert system shell. SPA was developed by BDM International, Inc., under sponsorship by the DOE Center for Computer Security at Los Alamos National Laboratory. SPA runs on an IBM or compatible personal computer. It presents a series of questions about the ADP security plan being reviewed. The SPA user references the ADP Security Plan and answers the questions. The SPA user reviews each section of the security plan, in any order, until all sections have been reviewed. The SPA user can stop the review process after any section and restart later. A Security Plan Review Report is available after the review of each section of the Security Plan. The Security Plan Review Report gives the user a written assessment of the completeness of the ADP Security Plan. SPA is being tested at Los Alamos and will soon be available to the DOE community.

43627 (LA-UR-90-2358) **Recursive least-squares learning algorithms for neural networks.** Lewis, P.S. (Los Alamos National Lab., NM (USA)); Hwang, Jenq-Neng. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9007117-3: SPIE conference on mathematical imaging, San Diego, CA (USA), Jul 1990). Order Number DE90014926. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents the development of a pair of recursive least squares (RLS) algorithms for online training of multilayer perceptrons, which are a class of feedforward artificial neural networks. These algorithms incorporate second order information about the training error surface in order to achieve faster learning rates than are possible using first order gradient descent algorithms such as the generalized delta rule. A least squares formulation is derived from a linearization of the training error function. Individual training pattern errors are linearized about the network parameters that were in effect when the pattern was presented. This permits the recursive solution of the least squares approximation, either via conventional RLS recursions or by recursive QR decomposition-based techniques. The computational complexity of the update is in the order of (N^2), where N is the number of network parameters. This is due to the estimation of the N x N inverse Hessian matrix. Less computationally intensive approximations of the RLS algorithms can be easily derived by using only block diagonal elements of this matrix, thereby partitioning the learning into independent sets. A simulation example is presented in which a neural network is trained to approximate a two dimensional Gaussian bump. In this example, RLS training required an order of magnitude fewer iterations on average (527) than did training with the generalized delta rule (6331). 14 refs., 3 figs.

43628 (LA-UR-90-2404) **Computer security in DOE distributed computing systems.** Hunteman, W.J. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007106-38: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014910. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The modernization of DOE facilities amid limited funding is creating pressure on DOE facilities to find innovative approaches to their daily activities. Distributed computing systems are becoming cost-effective solutions to improved productivity. This paper defines and describes typical distributed computing systems in the DOE. The special computer security problems present in distributed computing systems are identified and compared with traditional computer systems. The existing DOE computer security policy supports only basic networks and traditional computer systems and does not address distributed computing systems. A review of the existing policy requirements is followed by an analysis of the policy as it applies to distributed computing systems. Suggested changes in the DOE computer security policy are identified and discussed. The long lead time in updating DOE policy will require guidelines for applying the existing policy to distributed systems. Some possible interim approaches are identified and discussed. 2 refs.

43629 (ORNL/DSRD-25) **Workshop on neural networks.** Uhrig, R.E.; Emrich, M.L. Oak Ridge National Lab., TN (USA). Data Systems Research and Development Program. Jan 1990. 373p.

Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (CONF-8911136–Vugraphs: 1989 workshop on neural networks, Oak Ridge, TN (USA), 20 Nov 1989). Order Number DE90014794. Source: NTIS, PC A16/MF A01 - OSTI; GPO Dep.

The topics covered in this report are: Learning, Memory, and Artificial Neural Systems; Emerging Neural Network Technology; Neural Networks; Digital Signal Processing and Neural Networks; Application of Neural Networks to In-Core Fuel Management; Neural Networks in Process Control; Neural Network Applications in Image Processing; Neural Networks for Multi-Sensor Information Fusion; Neural Network Research in Instruments & Controls Division; Neural Networks Research in the ORNL Engineering Physics and Mathematics Division; Neural Network Applications for Linear Programming; Neural Network Applications to Signal Processing and Diagnostics; Neural Networks in Filtering and Control; Neural Network Research at Tennessee Technological University; and Global Minima within the Hopfield Hypercube.

43630 (ORNL/TM–9987) **ROSES, a robot operating system expert scheduler: Methodological framework.** Halbert, E.C.; Barhen, J.; Chen, P.C. Oak Ridge National Lab., TN (USA). Aug 1990. 87p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014782. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The optimal scheduling of tasks among which complex interrelationships (such as precedence constraints) may exist is essential for driving the new generation of concurrent supercomputers to their utmost performance. To address this need, the project ROSES (Robot Operating System Expert Scheduler) has been initiated at the Oak Ridge National Laboratory's Center for Engineering Systems Advanced Research. The project, its method for optimizing schedules, and its implementing computer code are each called ROSES. The problem of finding optimum schedules is explosive in complexity (i.e., NP-complete). By combining heuristic techniques, graph-theoretic algorithms, and sophisticated data structures, ROSES achieves near-optimal solutions in a highly efficient manner both with respect to computer time and memory-space. In this report, the description of the methodology is followed by an overview of the ROSES computer code, including detailed outlines of selected algorithms. In addition, this report describes an application of ROSES to schedule inverse dynamics computations for a robot manipulator. 45 refs., 9 tabs.

43631 (ORNL/TM–11349) **Treatment of systematic errors II: Fusion of ultrasound and visual sensor data.** Beckerman, M.; Farkas, L.A.; Johnston, S.E. Oak Ridge National Lab., TN (USA). Jun 1990. 25p. Sponsored by U.S. DOE Energy Research; U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. (CESAR–89/38). Order Number DE90014780. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this work we present a methodology for the fusion of ultrasound and visual sensor data as acquired by a mobile robot. The objective of the methodology was the reduction of systematic errors which arise in the processing of the data in the individual sensor domains. In the initial processing of the ultrasound scan, rectilinear (Cartesian map) and polar (strings) data structures were built. In the initial processing of the CCD camera image, vertical edge segments were identified and labeled according to their connectivity. The systematic errors treated included ultrasound distortions in size, and visual ambiguities in discriminating depth discontinuities from intensity gradients generated by other details in the image. These systematic errors were first flagged by comparing the ultrasound strings and visual vertical edges to one another. The ranges, spatial orientation of the camera, and geometric information extracted from least-squares fits were then used in the fusion stage processing of the visual image. Vertical edge information was used in the subsequent fusion stage processing of the ultrasound data. By the end of this feedback-like fusion process the data structures in each sensor domain carried some information from the other domain. We had identified the vertical edges of interest, tagged them with range information, and removed the distortions from the Cartesian navigation maps. 32 refs., 11 figs.

43632 (ORNL/TM–11559) **Asymptotic behavior of solutions of diffusion-like partial differential equations invariant to a family of affine groups.** Dresner, L. Oak Ridge National Lab., TN (USA). Jul 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014792. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report deals with the asymptotic behavior of certain solutions of partial differential equations in one dependent and two independent variables (call them c, z, and t, respectively). The partial differential equations are invariant to one-parameter families of one-parameter affine groups of the form: $c' = \lambda^{\alpha}c$, $t' = \lambda^{\beta}t$, $z' = \lambda z$, where λ is the group parameter that labels the individual transformations and α and β are parameters that label groups of the family. The parameters α and β are connected by a linear relation, $M\alpha + N\beta = L$, where M, N, and L are numbers determined by the structure of the partial differential equation. It is shown that when L/M and N/M are <0, certain solutions become asymptotic to $z^{L/M}t^{-N/M}$ for large z or small t. Some practical applications of this result are discussed. 8 refs.

43633 (ORNL/TM–11566) **Piecewise linear models of processor utilization.** Vose, M.D. (Tennessee Univ., Knoxville, TN (USA). Dept. of Computer Science). Oak Ridge National Lab., TN (USA). Jun 1990. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014774. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is part of a larger research effort to characterize the performance of parallel programs on distributed memory multiprocessors. We consider modeling processor utilization data by continuous piecewise linear approximations. We describe interactive tools for the identification of underlying trends and for the suppression of superfluous detail in processor utilization graphs. 5 refs., 4 figs.

43634 (ORNL/TM–11579) **The effect of multiprocessor radius on scaling.** Worley, P.H. Oak Ridge National Lab., TN (USA). Jun 1990. 32p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90014772. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In earlier work, it was established that, for a large class of linear partial differential equations (PDEs), increasing the problem size necessarily increases the execution time, independent of the algorithm and the number of processors used to solve the problem. In this paper, the analysis is extended to take into account the effect of the radius of the multiprocessor interconnection network on the growth in the execution time. Define r(p) to be the minimum radius over all subsets of p processors in a multiprocessor. An information-theoretic analysis is used to show that r(p) determines a lower bound on the communication cost of a parallel algorithm, and that this in turn determines a lower bound on the parallel execution time. Assume that $r(p) \geq \beta p^{\gamma} - \mu$ for positive constants β, γ, and μ for a given multiprocessor. For example, this type of lower bound on r(p) holds for a multiprocessor whose interconnection topology is a k-dimensional array. It is then established that, for the given class of PDEs, the time spent on interprocessor communication will be the dominant constraint on the performance of optimal algorithms when the problem and the multiprocessor are large. Moreover, as the problem and the multiprocessor increase in size, it is shown that the asymptotic increase in the parallel execution time will be determined by the communication cost and not by the computational requirements. The restriction to linear PDEs is not necessary, and similar results can be obtained for many problems in scientific computation. 25 refs.

43635 (SAND–89-3098C) **Weakly resolvable designs and unconditionally secure authentication codes.** Simmons, G.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9002132–1: 21. southeastern conference on combinatorics, graph theory and computing, Boca Raton, FL (USA), 12-16 Feb 1990). Order Number DE90014371. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A block design is said to be resolvable if the blocks can be partitioned into sets (resolutions) such that each element occurs once in each set, or in general α-resolvable if each element occurs exactly α times in each set. An α-resolvable design, $\alpha > 1$, is said to be separable if one or more of the resolutions can be further partitioned into subsets each of which is also a resolution, and

nonseparable otherwise. A design is affine if every block has the same number of elements in common with each block in the other resolutions. We introduce a new class of designs which we call weakly resolvable in which the blocks can be partitioned into sets such that each element occurs α_i times in set i: α_i not the same for all i, otherwise the design would be α-resolvable. The reason for the interest in weakly resolvable designs is that every nonseparable and affine weakly resolvable design corresponds in a natural way to a perfect and unconditionally secure authentication code that contains no proper subcode satisfying the same security requirements. 7 refs., 21 figs.

43636 (UCID–21709) **Nuclear Software Systems Division (NSSD) software testing and validation guidelines.** Leibee, A. Lawrence Livermore National Lab., CA (USA). 31 Jul 1987. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014795. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The importance of testing in the development of programs is well known. How to test programs is not. In this paper, we describe principles and procedures for testing software. These principles and procedures are presented in the context of the development of new software. However, they can be easily adapted to the testing of modifications to existing software. The subject of modification testing is covered after the presentation of the principles and procedures.

43637 (UCRL–53941) **Who's who in scientific visualization at LLNL.** Keller, P.; Van Dyke, P.T.; Strack, J.R. Lawrence Livermore National Lab., CA (USA). 4 May 1990. 159p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014720. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Who's Who In Scientific Visualization at LLNL is addressed to those involved in computer graphics activities at the Laboratory. Its broader purpose is to promote awareness and application of the new cluster of disciplines known as Visualization in Scientific Computing (VISC). VISC focuses on delivering information, rather than numbers, to the scientist. It combines computer graphics, image processing, computer vision, computer-aided design, signal processing, and user interface studies to provide information in a form that is understandable, relevant to the problem at hand, and useable. A major emphasis of VISC is the output or display of meaningful computer-generated images. The information in Who's Who is based on a Laboratory-wide survey of scientists, engineers, and programmers. With the cooperation of our respondents, we have assembled a catalog of current computer-graphics expertise and interests at LLNL. Our survey revealed – not surprisingly – a widespread interest in VISC and significant activity in VISC-related disciplines. Our hope is that by helping to knit together this community of interests, Who's Who will stimulate further progress in VISC. To maintain its utility as a timely resource, we plan to update Who's Who periodically.

43638 (UCRL-CR–104308) **Animated computer-generated video-tape instruction using DIGLIB [Device Independent Graphics Library]: Final report.** Begg, Z. (Howard Univ., Washington, DC (USA). School of Engineering); Thomas, A.; Semple, W.A. Lawrence Livermore National Lab., CA (USA); Howard Univ., Washington, DC (USA). School of Engineering. 19 Jun 1990. 213p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015360. Source: NTIS, PC A10/MF A01 - OSTI.

The objective of the manual is to discuss the details, a software developer may need to develop educational movies. The manual is organized in a manner that the user can browse through each chapter of the manual and later, can work on the functions provided in the driver. In the end, the user would be capable of developing the educational movies. The manual is intended both for the end user, who wants to write programs to develop movies, and for the system programmer/debugger, who either wants to extend the capabilities of the system or wants to debug the system.

43639 (UCRL-ID–104567) **Pasting POSTSCRIPT files into T_EX.** Yorkey, T.J. Lawrence Livermore National Lab., CA (USA). 21 Jun 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014799. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This note describes how to get POSTSCRIPT files into T_EX documents on a Sun computer using psifg. Several applications generating POSTSCRIPT files are used as examples. These applications are: Adobe Illustrator, Mathematica, View, Cricket Graph and MacDraw, and a scanned image. I assume the reader knows nothing about POSTSCRIPT, and does not want to learn anything about it.

43640 (UCRL-JC–104001) **An asymptotically induced domain decomposition method for parabolic boundary layer problems.** Rodrigue, G. (California Univ., Davis, CA (USA). Dept. of Applied Science); Reiter, E. Lawrence Livermore National Lab., CA (USA). [1990]. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9002131–1: Workshop on asymptotic analysis and numerical solution of partial differential equations, Argonne, IL (USA), 26-28 Feb 1990). Order Number DE90014620. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An iterative method for computing an approximation to the solution of the singularly perturbed elliptic partial differential equation $(\partial u/\partial x) - \varepsilon\Delta u = 0$ is described. Smoothness of the boundary conditions are established that will enable the iterates to asymptotically approximate the parabolic boundary layers of the solution. A domain decomposition technique based around the results of the asymptotic analysis is developed to numerically solve the above differential equation when the boundary functions are discontinuous. Convergence results of the numerical scheme are established and a computational example is given. Divergence is computationally examined. 7 refs.

43641 Questions and unexpected answers in concurrent computation. Fox, G.C. (California Inst. of Tech., Pasadena, CA (USA)). pp. 97-122 of Experimental parallel computing architectures. Dongarra, J.J. Elsevier Science Pub. Co., Inc., New York, NY (USA) (1987).

The authors describe a concurrent computation program which is used to study fundamental issues in parallel computation. The authors illustrate the progress of our research by describing the questions asked; the research motivated by these questions and the expected and often unexpected answers obtained.

43642 An overview of the NYU Ultracomputer project. Gottlieb, A. (New York Univ. Ultracomputer Research Project, Courant Inst. of Mathematical Sciences, Div. of Computer Science, New York, NY (US)). pp. 25-96 of Experimental parallel computing architectures. Dongarra, J.J. Elsevier Science Pub. Co., Inc., New York, NY (USA) (1987).

The NYU Ultracomputer is a shared memory MIMD parallel computer design to contain thousands of processors connected by an Omega network to a like number of memory modules. A new coordination primitive fetch-and-add is defined and the network is enhanced to combine simultaneous requests, including fetch-and-adds, directed at the same memory location. This paper discusses work on architecture, programming models, system software, hardware and VLSI design, performance analysis, and simulation studies.

43643 Parallel supercomputing today and the Cedar approach. Kuck, D.J. (Illinois Univ., Urbana, IL (USA). Center for Supercomputing Research and Development); Davidson, E.S.; Lawrie, D.H.; Sameh, A.H. pp. 1-24 of Experimental parallel computing architectures. Dongarra, J.J. Elsevier Science Pub. Co., Inc., New York, NY (USA) (1987).

More and more scientists and engineers are becoming interested in using supercomputers. Earlier barriers to using these machines are disappearing as software for their use improves. Meanwhile, new parallel supercomputer architectures are emerging that may provide rapid growth in performance. These systems may use a large number of processors with an intricate memory system that is both parallel and hierarchical; they will require even more advanced software. Compilers that restructure user programs to exploit the machine organization seem to be essential. A wide range of algorithms and applications are being developed in an effort to provide high parallel processing performance in many fields.

The Cedar supercomputer, presently operating with eight processors in parallel is discussed. It uses advanced system and applications software. This software should allow the number of processors in Cedar to be doubled annually, providing rapid performance advances in the next decade.

43644 Using linear congruential generators for parallel random number generation. Durst, M.J. (Lawrence Livermore National Lab., Livermore, CA (US)). pp. 462-466 of Proceedings of the 1989 winter simulation conference. MacNair, E.A.; Heidelberger, P.; Musselman, K.J. Association for Computing Machinery, New York, NY (USA) (1989). DOE Contract W-7405-ENG-48. (CONF-891275–: 1989 winter simulation conference, Washington, DC (USA), 4-6 Dec 1989).

Linear congruential random number generators are widely used in simulation and Monte Carlo calculations. Because they are very fast, and because they have minimal state space, they remain attractive for use in parallel computing environments. The authors discuss their use as a source for many streams of pseudo-random numbers. Many authors have discussed splitting the stream of a single CRNG into many substreams; the authors show spectral calculations for this scheme and compare randomly and regularly spaced selected using a common multiplier for all streams and a unique additive constant for each. The discrepancies of such schemes are not better than for splitting schemes; we show how they are in a sense equivalent. The authors also consider the use of distinct multipliers for each stream. Good multipliers are abundant for large enough moduli, but little is know about the multidimensional behavior of such generators. The authors discuss the use of improvement techniques and larger moduli to overcome the limitations of linear congruential generators.

43645 Standard 90.1's ENVSTD: Using it for compliance. Crawley, D.B. (Pacific Northwest Lab., Richland, WA (USA)); Boulin, J.J. *ASHRAE Journal (American Society of Heating, Refrigerating and Air-Conditioning Engineers) (USA)*, 32(5): 30-40 (May 1990). DOE Contract AC06-76RL01830.

This article describes the ENVSTD software program of Standard 90.1-1989. This standard defines system performance requirements for building envelopes. The authors discuss how ENVSTD can be used to determine design compliance with Standard 90.1-1989.

43646 Performance of various computers using standard linear equations software. Dongarra, J.J. (Oak Ridge National Lab., TN (USA). Mathematical Sciences Section). *Computer Architecture News (USA)*, 18(1): 17-31 (Mar 1990). DOE Contract AC05-84OR21400.

This report provides performance information on a wide assortment of computers ranging from the home-used PC up to the most powerful supercomputers. The information has been collected over a period of time and will undergo change as new machines are added and as hardware and software systems improve. The programs used to generate this data can easily be obtained over the internet.

43647 Vector generator scan converter. Moore, J.M.; Leighton, J.F. To Dept. of Energy, Washington, DC (USA). USA Patent 4918624/A/. 17 Apr 1990. Filed date 5 Feb 1988. USA Patent Application 7-152,900. Int. Cl. G06F 15/66. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes high printing speeds for graphics data that are achieved with a laser printer by transmitting compressed graphics data from a main processor over an I/O (input/output) channel to a vector generator scan converter which reconstructs a full graphics image for input to the laser printer through a raster data input port. The vector generator scan converter includes a microprocessor with associated microcode memory containing a microcode instruction set, a working memory for storing compressed data, vector generator hardware for drawing a full graphic image from vector parameters calculated by the microprocessor, image buffer memory for storing the reconstructed graphics image and an output scanner for reading the graphics image data and inputting the data to the printer. The vector generator scan converter eliminates the bottleneck created by the I/O channel for transmitting graphics data from the main processor to the laser printer, and increases printer speed up to thirty fold.

9903 Information Handling

Refer also to citation(s) 42583, 42653, 42770, 42851, 42858, 43195

43648 (CONF-831186–1) **Improved information processing and dissemination through the introduction of new technology.** Spath, C.E.; Marsh, F.E. Jr. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (USA). Oct 1983. 18p. Sponsored by U.S. DOE Management & Administration. From 11. annual conference of the DOE/Contractors Micrographics Association; Oak Ridge, TN (USA); 2-4 Nov 1983. Order Number DE83017978. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topic on information technology: technology signals a liberation; application of information technology; optical character recognition; optical memories; and planning considerations and the future.

43649 (SAND–90-0839C) **Study of methods to enhance the control and protection of classified documents.** Tucker, M.D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007106–32: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90014370. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For many years, the protection and control of classified documents has been a concern of administrative and management personnel. Recent thefts of documents has increased this concern and has led to high level committee investigations into improved classified document protection techniques. Better methods must be found to improve classified document protection and control systems. From preliminary investigations, it was determined that there is not one technique or method that alone would provide adequate protection of classified documents. Instead, a systematic approach that would utilize several components must be used. These components would limit the unauthorized access to classified documents, improve the accountability of documents, increase the protection of documents during transfers, protest classified documents against unauthorized reproduction, protect classified documents against unauthorized removal from a security area, and verify that documents that have been flagged for destruction are actually physically destroyed. This study investigates several techniques that could be implemented in each of these six areas. 8 refs.

43650 Study of methods for the enhancement of classified document control and protection SAND88-3062C. Tucker, M.D. (Security Systems Implementation Div., Sandia National Lab., Albuquerque, NM (US)). pp. 27-34 of Proceedings of the 1989 Carnahan conference on security technology: Crime countermeasures. DeVore, R.W. University of Kentucky, Lexington, KY (USA) (1989). (CONF-890591–: 1989 Carnahan conference on security technology: crime countermeasures, Lexington, KY (USA), 16-17 May 1989).

The protection of classified documents is a concern of administrative and management personnel. Recent thefts of documents has increased this concern and has led to high level committee investigations into improved classified document protection techniques. It has been determined that there is not one technique or method that alone would provide adequate protection of classified documents. Thus, it has been decided to break the problem into smaller parts and to propose a systematic approach that would utilize several components to increase the protection of classified documents. These components would limit the unauthorized access to classified documents, increase the protection of documents during transfers between accountability stations, protect documents against unauthorized reproduction, protect classified documents against the unauthorized removal from a secured area, and verify that documents that have been flagged for destruction are actually physically destroyed. This study investigates techniques that could be implemented in each of these five areas and how these techniques can be combined to develop a classified document protection system.

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CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)
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44604	15:43323	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011201	MF-408
44770	15:43241	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015135	MF-402
44771	15:42581	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015133	MF-511
44772	15:42582	NTIS, PC A05/MF A01; OSTI; INIS		DE90015134	MF-511
44773	15:43337	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015092	MF-400
44777	15:42629	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015093	MF-400
44821	15:43242	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015085	MF-402
44823	15:43149	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015088	MF-414
44830	15:42939	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015086	MF-404
44839	15:43338	NTIS, PC A03/MF A01 - OSTI		DE90015126	MF-408
52248	15:43162	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014754	PC-414
BONN-IR–					
90-08	15:43443	NTIS (US Sales Only), PC A08/MF A01		DE90512911	
90-11	15:43444	NTIS (US Sales Only), PC A05/MF A01		DE90513085	
90-13	15:43196	NTIS (US Sales Only), PC A04/MF A01		DE90513086	
90-19	15:43197	NTIS (US Sales Only), PC A04/MF A01		DE90513087	
CAL–					
1793	15:43367	*See* N–90-22467			

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CBPF-NF–					
004/89	15:43552	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634539	
005/88	15:43445	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634906	
011/89	15:43492	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635077	
017/89	15:43553	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634540	
018/89	15:43574	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634418	
019/89	15:43516	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635034	
020/86	15:43446	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634962	
023/89	15:43458	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634501	
027/88	15:43351	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634892	
033/87	15:43352	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634866	
036/89	15:43447	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634963	
065/88	15:43575	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634419	
066/88	15:43576	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634420	
070/87	15:43353	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634867	
070/88	15:43031	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635108	
072/88	15:43354	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634868	
073/88	15:43554	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634536	
074/88	15:43555	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634537	
076/88	15:43556	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634541	
079/88	15:43557	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634542	
081/88	15:43558	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634543	
082/88	15:43559	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634544	
083/88	15:43560	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634545	
CDTN-DERL-PD–					
003/83	15:43550	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635348	
005/82	15:42744	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90635305	
007/85	15:43243	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635227	
008/84	15:43551	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635331	
CDTN-DETM-DIPRS–					
002/81	15:42385	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635174	
016/83	15:42386	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90635175	
CDTN-DETM-PD–					
012/85	15:43284	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635217	
015/84	15:42387	NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS		DE90635176	
CDTN-DETR-PD–					
016/85	15:42738	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90635538	
018/85	15:42671	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635484	

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CDTN-DETS-PD–					
001/84	15:43117	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635420	
001/85	15:42672	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635485	
003/84	15:42406	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90635342	
009/83	15:42940	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635192	
010/82	15:42941	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635193	
012/85	15:42673	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90635486	
019/82	15:42674	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635487	
039/81	15:43127	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635468	
CEA-CONF–					
10031	15:43032	NTIS (US Sales Only), PC A02/MF A01		DE90511936	
10042	15:42388	NTIS (US Sales Only), PC A03/MF A01		DE90511935	
10047	15:43118	NTIS (US Sales Only), PC A02/MF A01		DE90511932	
10180	15:42989	NTIS (US Sales Only), PC A03/MF A01		DE90511934	
CEA-DAS–					
635	15:42747	NTIS (US Sales Only), PC A05/MF A01		DE90511913	
CEA-IPSN-RA–					
1988	15:42583	NTIS (US Sales Only), PC A08/MF A01		DE90511912	
CEA-LETI-RA–					
1988	15:43195	NTIS (US Sales Only), PC A07/MF A01		DE90512027	
CEAC-R–					
1(90)	15:43285	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635218	
CERN–					
89-12.-Pt.1(ed.2)	15:42990	NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS		DE90635206	
90-01	15:43150	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635424	
CESAR–					
89/38	15:43631	*See* ORNL/TM–11349			
90/30	15:43119	*See* CONF-9007134–1			
CHRI-RVG–					
5860-1	15:42873	NTIS (US Sales Only), PC A03/MF A01		DE90509335	
CIEMAT–					
644	15:43198	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635592	
645	15:43199	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635593	
646	15:43200	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635594	
647	15:43201	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635595	
648	15:43202	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90635596	
CMI-R–					
90/A30001	15:42349	NTIS (US Sales Only), PC A05/MF A01		DE90512584	
CONF-831186–		(11. annual conference of the DOE/Contractors Micrographics Association; Oak Ridge, TN (USA); 2-4 Nov 1983)			
1	15:43648	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE83017978	PC-900
CONF-8604259–		(21. winter school of physics; Zakopane (Poland); 7-11 Apr 1986)			
	15:43568	*See* INP–1343/PS			
CONF-860583–		(International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY (USA); 12-16 May 1986)			
9	15:43155	*See* SSC–77			
10	15:43188	*See* SSC–71			
CONF-860870–		(13. international conference on high energy accelerators; Novosibirsk (USSR); 7-11 Aug 1986)			
25	15:43168	*See* SSC–84			

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CONF-860911–		(192. American Chemical Society national meeting; Anaheim, CA (USA); 7-12 Sep 1986)			
34	15:43015	*See* UCRL–94406			
CONF-860963–		(SPIG '86: international symposium and summer school on the physics of ionized gases; Sibenik (Yugoslavia); 1-5 Sep 1986)			
	15:43596	Nova Science Publishers, Inc., 283 Commack Rd., Suite 300, Commack, NY 11725 (USA)			
CONF-8610108–		(2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX (USA); 23-29 Oct 1986)			
9	15:43169	*See* SSC–105			
CONF-861124–		(18. symposium on optical materials for high power lasers; Boulder, CO (USA); 3-5 Nov 1986)			
	15:43217	US Government Printing Office, North Capitol and H St. NW, Washington, DC 20401 (USA)			
CONF-870302–		(Particle accelerator conference; Washington, DC (USA); 16-19 Mar 1987)			
260	15:43157	*See* SSC–117			
261	15:43172	*See* SSC–119			
262	15:43158	*See* SSC–120			
263	15:43173	*See* SSC–122			
264	15:43189	*See* SSC–115			
265	15:43156	*See* SSC–114			
266	15:43170	*See* SSC–113			
267	15:43159	*See* SSC–123			
268	15:43171	*See* SSC–116			
CONF-8706398–		(Surfactant-based mobility control: progress in miscible-flood enhanced oil recovery; Ann Arbor, MI (USA); 21-24 Jun 1987)			
	15:42358	American Chemical Society, 1155 Sixteenth St. NW, Washington, DC 20036 (USA)			
CONF-8708156–		(Spatial displays and spatial instruments; Asilomar, CA (USA); 31 Aug - 3 sep 1987)			
	15:43228	*See* N–90-22918			
CONF-870867–		(2. international symposium on rock fragmentation by blasting; Keystone, CO (USA); 23-26 Aug 1987)			
	15:42379	Society for Experimental Mechanics in Reactor Technology 7 School Street, Bethel, CT 06801 (USA)			
CONF-8709494–		(Workshop on physics of intermediate and high energy heavy ion reactions; Cracow (Poland); 28 Sep 1987)			
	15:43538	*See* INP–1393/PH			
CONF-8711345–		(The hadron structure '87; Smolenice (Czechoslovakia); 16 Nov 1987)			
	15:43449	*See* INP–1387/PH			
CONF-8803271–		(Free-space power transmission workshop; Cleveland, OH (USA); 29-30 Mar 1988)			
	15:42814	*See* N–90-21795			
CONF-8806156–		(IAEA specialists meeting on high-temperature metallic materials for gas-cooled reactors; Cracow (Poland); 20-23 Jun 1988)			
	15:42687	*See* IWGGCR–18			
CONF-8806260–		(19. international symposium on multiparticle dynamics - new data and theoretical trends; Arles (France); 13-17 Jun 1988)			
	15:43451	*See* INP–1427/PH			
CONF-8806489–		(Seminar on radioactive waste disposal; Juelich (Germany, F.R.); 14-15 Jun 1988)			
	15:42539	*See* Juel-Conf–65			
CONF-880802–		(22. international symposium on combustion; Seattle, WA (USA); 14-19 Aug 1988)			
	15:42342				
CONF-880920–		(International symposium on energy options for the year 2000: contemporary concepts in technology and policy; Wilmington, DE (USA); 14-17 Sep 1988)			
	15:42891	University of Delaware, Newark, DE 19716 (USA)			

CONF-880920–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	15:42892	University of Delaware, Newark, DE 19716 (USA)			
CONF-8809492–		(French 3. Cycle interuniversity wokshop on Nuclear Physics; Esneux (France); 14-16 Sep 1988)			
	15:43452	*See* IPNO-TH–89-32			
CONF-8810519–		(Seminar on conditioning and final storage of radioactive wastes from collecting depots of the Federal States; Braunschweig (Germany, F.R.); 21 Oct 1988)			
	15:42560	*See* PTB-SE–23			
CONF-8811172–		(Hadron structure' 88; Piestany (Czechoslovakia); 14-18 Nov 1988)			
	15:43541	*See* INP–1433/PH			
CONF-8811333–		(KTG conference on advanced LWR fuel elements: Design, performance and reprocessing; Karlsruhe (Germany, F.R.); 17-18 Nov 1988)			
	15:42665	*See* KFK–4589			
CONF-8812141–		(Scope workshop, landscape boundaries: consequence for biotic diversity and ecological flows; Paris (France); 12-16 Dec 1988)			
1	15:43286	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014211	MF-402
CONF-8812142–		(German-French colloquium: is the greenhouse effect a problem of the 21st century; Neuherberg (Germany, F.R.); 13-14 Dec 1988)			
	15:43249	*See* GSF–3/90			
CONF-890114–		(14. workshop on geothermal reservoir engineering; Stanford, CA (USA); 24-26 Jan 1989)			
7	15:42644	*See* LBL–26869			
CONF-890425–		(American power conference; Chicago, IL (USA); 24-26 Apr 1989)			
	15:42627				
	15:42658				
	15:42662				
	15:42663				
	15:42670				
	15:42714				
	15:42742				
	15:42813				
	15:43147				
	15:43573				
CONF-8905213–		(QED structure functions workshop; Ann Arbor, MI (USA); 22-25 May 1989)			
	15:43466	*See* LAL–8939			
CONF-8905282–		(5. Saturne meeting; Piriac (France); 16-20 May 1989)			
	15:43437	*See* IPNO-DRE–89-17			
	15:43471	*See* IPNO-DRE–89-16			
CONF-8905339–		(SFEN day on TMI reactor accident. Balance ten years after; Paris (France); 30 May 1989)			
	15:42747	*See* CEA-DAS–635			
CONF-890617–		(2. Karlsruhe international conference on analytical chemistry in nuclear technology; Karlsruhe (Germany, F.R.); 5-9 Jun 1989)			
	15:43032	*See* CEA-CONF–10031			
CONF-8906244–		(Responding to the threat of global warming: options for the Pacific and Asia; Honolulu, HI (USA); 21-27 Jun 1989)			
	15:43240	*See* ANL/EAIS/TM–17			
CONF-8906346–		(5. International Conference on Radiation Effects in Insulation; Hamilton (New Zealand); 19-23 Jun 1989)			
	15:42989	*See* CEA-CONF–10180			
CONF-890701–		(International cryogenic materials conference; Los Angeles, CA (USA); 24-28 Jul 1989)			
	15:43118	*See* CEA-CONF–10047			
CONF-8907102–					
	15:42388	*See* CEA-CONF–10042			

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CONF-8907145–		(Biomonitoring and carcinogen risk assessment meeting; Cambridge (UK); 27-28 Jul 1989)			
2	15:43318	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015561	MF-408
CONF-8907154–		(Enrico Fermi summer course CX11: nuclear collisions from the mean field into the fragmentation regime; Varenna (Italy); 11-21 Jul 1989)			
	15:43519	*See* HMI-B–473			
CONF-8908240–		(Workshop on new phenomenology in high energy physics and cosmology; TRIESTE (Italy); 16-17 Aug 1989)			
	15:43459	*See* LAL–8940			
CONF-890841–		(International workshop on safety of nuclear installations of the next generation and beyond; Chicago, IL (USA); 28-31 Aug 1989)			
	15:42748	*See* IAEA-TECDOC–550			
CONF-890855–		(10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989)			
	15:42780	American Association for Structural Mechanics in Reactor Technology, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
	15:42781	American Association for Structural Mechanics in Reactor Technology, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
	15:42782	American Association for Structural Mechanics in Reactor Technology, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
	15:42783	American Association for Structural Mechanics in Reactor Technology, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
CONF-8910354–		(DNA damage and repair in human tissues conference; Upton, NY (USA); 1-4 Oct 1989)			
2	15:43338	*See* BNL–44839			
CONF-8910358–		(Spacecraft charging technology conference; Monterey, CA (USA); 31 Oct - 3 nov 1989)			
	15:42631	*See* N–90-22488			
CONF-8910434–		(International workshop on understanding global environmental change; Worcester, MA (USA); 11-13 Oct 1989)			
1	15:43244	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014455	MF-402
CONF-8910439–		(36. national symposium and topical conference; Boston, MA (USA); 23 Oct 1989)			
	15:42973	*See* N–90-22421			
CONF-891113–		(American Institute of Chemical Engineers annual meeting; San Francisco, CA (USA); 5-10 Nov 1989)			
12	15:42939	*See* BNL–44830			
CONF-8911136–		(1989 workshop on neural networks; Oak Ridge, TN (USA); 20 Nov 1989)			
Vugraphs	15:43629	*See* ORNL/DSRD–25			
CONF-891115–		(ASTM symposium on composite materials: fatigue and fracture; Orlando, FL (USA); 6-9 Nov 1989)			
	15:43006	*See* N–90-22646			
CONF-8911169–		(3. research co-ordination meeting on measurements and analysis of double differential neutron spectra in (p,n) and (alpha,n) reactions; Bologna (Italy); 13-15 Nov 1989)			
	15:43470	*See* INDC(NDS)–234			
CONF-8911189–		(International symposium on immunoscintigraphy facts and fictions; Gottingen (Germany, F.R.); 2-4 Nov 1989)			
1	15:43323	*See* BNL–44604			
CONF-8911192–		(1989 Boulder damage symposium; Boulder, CO (USA); 1-3 Nov 1989)			
5	15:42976	*See* UCRL–101769			
CONF-8911214–		(Standardization of carbon-phenolic test methods and specifications advisory committee meeting; Tempe, AZ (USA); 16 Nov 1989)			
	15:42999	*See* N–90-21817			

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CONF-900113–		(5. international workshop on atomic physics for ion driven fusion; Schliersee (Germany, F.R.); 29 Jan - 4 feb 1990)			
	15:43181	*See* GSI–90-21(prepr.)			
CONF-900160–		(14. annual conference on composites and advanced ceramics; Cocoa Beach, FL (USA); 14-17 Jan 1990)			
	15:43003	*See* N–90-21826			
4	15:42996	*See* LA-UR–90-2431			
CONF-900193–		(Division of particle; Houston, TX (USA); 2 Jan 1990)			
4	15:43442	*See* UCRL-JC–103454			
5	15:43440	*See* SLAC-PUB–5240			
CONF-9002131–		(Workshop on asymptotic analysis and numerical solution of partial differential equations; Argonne, IL (USA); 26-28 Feb 1990)			
1	15:43640	*See* UCRL-JC–104001			
CONF-9002132–		(21. southeastern conference on combinatorics, graph theory and computing; Boca Raton, FL (USA); 12-16 Feb 1990)			
1	15:43635	*See* SAND–89-3098C			
CONF-9002133–		(IVL-Konferensen 1990; Stockholm (Sweden); 14 Feb 1990)			
	15:43238	*See* IVL-B–981			
CONF-9002135–		(2. superplasticity in aerospace meeting; Anaheim, CA (USA); 18-22 Feb 1990)			
1	15:42958	*See* UCRL-JC–103631			
CONF-900246–		(23. Health Physics Society midyear topical symposium on risk analysis; Atlantic City, NJ (USA); 4-9 Feb 1990)			
6	15:43325	*See* WHC-SA–0744			
CONF-9003154–		(Workshop on atomic physics at the Advanced Photon Source; Argonne, IL (USA); 23-30 Mar 1990)			
3	15:43419	*See* BNL–44534			
CONF-900321–		(Physics with high-intensity hadron accelerators; Tokyo (Japan); 14-16 Mar 1990)			
	15:43448	*See* GSI–90-22(prepr.)			
CONF-900348–		(2. international industrial symposium on the super collider; Miami, FL (USA); 14-16 Mar 1990)			
11	15:43180	*See* FNAL-TM–1669			
12	15:43149	*See* BNL–44823			
CONF-900381–		(7. annual coal-fueled heat engines and gas stream cleanup systems contractors review meeting; Morgantown, WV (USA); 26-28 Mar 1990)			
	15:42332	*See* DOE/METC–90/6110			
CONF-900396–		(IRIS Specialty Group meeting on passive sensors and atmospheric physics; Laurel, MD (USA); 13 Mar 1990)			
4	15:43012	*See* SAND–90-0955C			
CONF-900402–		(199. national meeting of the American Chemical Society; Boston, MA (USA); 22-27 Apr 1990)			
	15:43101	American Chemical Society, Division of Nuclear Chemistry and Technology, 1155 16th St., N.W. Washington, DC 20036			
CONF-900406–		(1. international topical meeting on high-level radioactive waste management; Las Vegas, NV (USA); 8-12 Apr 1990)			
70	15:42569	*See* UCRL–102116			
CONF-9004209–		(Workshop on the science of intense radioactive ion beams; Los Alamos, NM (USA); 10-12 Apr 1990)			
4	15:43571	*See* LA-UR–90-2580			
5	15:43474	*See* LA-UR–90-2594			
CONF-9004221–		(1. international conference on electrophoresis, superconducting and the human genome; Tallahassee, FL (USA); 10-13 Apr 1990)			
2	15:43319	*See* LA-UR–90-2373			
3	15:43320	*See* UCRL–102887			

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4	15:43304	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015182	MF-408
CONF-9004225--		(Conference on baryon number violation at the SSC; Santa Fe, NM (USA); 27-30 Apr 1990)			
2	15:43454	*See* LA-UR-90-2462			
CONF-900423--		(13. international cryogenic engineering conference (ICEC-13); Beijing (China); 24-27 Apr 1990)			
2	15:43137	*See* LBL-28843			
CONF-9004232--		(1. Angstrom FEL workshop; Sag Harbor, NY (USA); 22-27 Apr 1990)			
2	15:43135	*See* LA-UR-90-2294			
CONF-9004234--		(1990 SANIBEL symposia; St. Augustine, FL (USA); Apr 1990)			
1	15:43115	*See* UCRL-JC-103246			
CONF-900426--		(7. SPE/DOE symposium on enhanced oil recovery; Tulsa, OK (USA); 22-25 Apr 1990)			
	15:42350	Society of Petroleum Engineers, P.O. Box 833836, Richardson, TX 75083-3836			ND-122
CONF-900449--		(12. annual American Society of Mechanical Engineers (ASME) international solar energy conference; Miami, FL (USA); 1-4 Apr 1990)			
	15:42642	*See* N-90-21974			
CONF-900466--		(Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990)			
	15:42632	*See* N-90-22843			
74	15:43010	*See* SAND-90-0146C			
CONF-900492--		(10. ASTM symposium on composite materials: testing and design; San Francisco, CA (USA); 24-25 Apr 1990)			
	15:43009	*See* N-90-22822			
CONF-900513--		(Conference on the tribology of composite materials; Oak Ridge, TN (USA); 1-3 May 1990)			
	15:42998	*See* N-90-20130			
2	15:42991	NTIS, PC A02/MF A01 - OSTI		DE90014224	MF-373
CONF-9005149--		(4. national outdoor action conference on aquifer restoration, groundwater monitoring, and geophysical methods; Las Vegas, NV (USA); 14-17 May 1990)			
6	15:43348	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013025	
CONF-9005175--		(Automatic RF Technology Group (ARFTG) conference; Dallas, TX (USA); 10-11 May 1990)			
2	15:43226	*See* KCP-613-4292			
CONF-9005235--		(7. international symposium on molten salts; Montreal (Canada); 6-11 May 1990)			
3	15:42988	*See* BNL-43723			
CONF-9005237--		(10. annual conference on nonlinear science: the next decade; Los Alamos, NM (USA); 21-25 May 1990)			
2	15:43580	*See* LA-UR-90-2271			
CONF-9005238--		(Symposium in honor of Akito Arima: nuclear physics in the 1990's; Santa Fe, NM (USA); 1-5 May 1990)			
2	15:43545	*See* LA-UR-90-2258			
CONF-9005247--		(International conference on radiation material science; Alushta (USSR); 22-25 May 1990)			
1	15:42746	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014450	MF-404
CONF-9005248--		(Evolution in astrophysics: IUE astronomy in the era of new space missions; Toulouse (France); 29 May - 1 jun 1990)			
1	15:43363	*See* LA-UR-90-2372			
3	15:43364	*See* LA-UR-90-2388			
CONF-9005249--		(Confrontation between stellar pulsation and evolution; Bologna (Italy); 28-31 May 1990)			
1	15:43359	*See* LA-UR-90-2367			
1	15:43362	*See* LA-UR-90-2370			
2	15:43358	*See* LA-UR-90-2366			
3	15:43361	*See* LA-UR-90-2369			
4	15:43360	*See* LA-UR-90-2368			
5	15:43357	*See* LA-UR-90-2365			

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CONF-9005251–		(Workshop on quark-gluon structure of hadrons and nuclei; Shanghai (China); 28 May - 1 jun 1990)			
1	15:43546	*See* LA-UR–90-2279			
CONF-9005252–		(International conference on global and regional environmental atmospheric chemistry; Beijing (China); 3-10 May 1990)			
1	15:43280	*See* UCRL-JC–104052			
CONF-9005253–		(International symposium on short wavelength lasers and their applications; Samarkand (USSR); 14-18 May 1990)			
1	15:43143	*See* UCRL-JC–104125			
CONF-9005254–		(3. international spring seminar on nuclear physics: understanding the variety of nuclear excitations; Ischia (Italy); 21-25 May 1990)			
	15:43514	*See* GSI–90-27(prepr.)			
CONF-9005257–		(International school on nuclear physics; Kiev (USSR); 28 May - 8 jun 1990)			
	15:43194	*See* GSI–90-23(prepr.)			
CONF-900534–		(18. NATO/CCMS international technical meeting on air pollution modelling and its applications; Vancouver (Canada); 13-17 May 1990)			
3	15:43278	*See* UCRL–102141			
CONF-900542–		(21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference; Kissimmee, FL (USA); 21-25 May 1990)			
	15:42630	*See* N–90-21812			
14	15:42629	*See* BNL–44777			
15	15:43337	*See* BNL–44773			
CONF-900570–		(8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90; Menton (France); 7-11 May 1990)			
1	15:43438	*See* LA-UR–90-2433			
CONF-900601–		(12. international conference on particles and nuclei; Cambridge, MA (USA); 24-29 Jun 1990)			
2	15:43439	*See* LA-UR–90-2530			
CONF-900603–		(2. European particle accelerator conference; Nice (France); 11-16 Jun 1990)			
27	15:43164	*See* FNAL/C–90/134			
28	15:43179	*See* FNAL/C–90/122			
29	15:43184	*See* SLAC-PUB–5276			
CONF-900608–		(American Nuclear Society annual meeting; Nashville, TN (USA); 10-14 Jun 1990)			
50	15:43291	*See* LBL–28426			
CONF-9006146–		(34. international power sources symposium; Cherry Hill, NJ (USA); 25-28 Jun 1990)			
	15:42836	*See* N–90-21844			
CONF-9006176–		(19. power modulator symposium; San Diego, CA (USA); Jun 1990)			
10	15:43140	*See* SAND–90-0415C			
11	15:43142	*See* UCRL–102850			
CONF-9006195–		(Free Lagrange conference; Jackson Lake, WY (USA); 3-7 Jun 1990)			
3	15:43572	*See* UCRL-JC–104257			
4	15:43548	*See* LA-UR–90-2268			
5	15:43581	*See* UCRL-JC–104258			
6	15:43582	*See* UCRL-JC–104266			
CONF-9006241–		(38. ASMS conference on mass spectrometry and allied topics; Tucson, AZ (USA); 4-8 Jun 1990)			
4	15:43427	*See* PNL-SA–18437			
CONF-9006246–		(BES material science program information and review meeting; Albuquerque, NM (USA); 20-21 Jun 1990)			
1	15:43013	*See* SAND–90-1582C			
CONF-9006247–		(4. annual thick composites in compression workshop; Knoxville, TN (USA); 26-28 Jun 1990)			
2	15:43132	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014446	MF-406

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CONF-9006248–		(8. international congress on cybernetics and systems; New York, NY (USA); 11-15 Jun 1990)			
1	15:43624	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014452	MF-405
CONF-9006249–		(The environment: global problems – local solutions; Hempstead, NY (USA); 7-9 Jun 1990)			
1	15:43242	*See* BNL–44821			
CONF-9007106–		(Institute of nuclear materials management conference; Los Angeles, CA (USA); 15-18 Jul 1990)			
31	15:42610	*See* SAND–90-0667C			
32	15:43649	*See* SAND–90-0839C			
33	15:42611	*See* SAND–90-0742C			
34	15:42584	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014457	MF-406
36	15:42612	*See* SAND–90-0773C			
37	15:42609	*See* LA-UR–90-2486			
38	15:43628	*See* LA-UR–90-2404			
39	15:42558	*See* LA-UR–90-2384			
41	15:42706	*See* LA-UR–90-2405			
42	15:43129	*See* LA-UR–90-2410			
43	15:42608	*See* LA-UR–90-2342			
44	15:43037	*See* LA-UR–90-2355			
45	15:42705	*See* LA-UR–90-2357			
48	15:42557	*See* LA-UR–90-2254			
49	15:42556	*See* LA-UR–90-2253			
52	15:42607	*See* LA-UR–90-2259			
53	15:43626	*See* LA-UR–90-2260			
CONF-9007111–		(8. international conference on high-power particle beams; Novosibirsk (USSR); 2-5 Jul 1990)			
10	15:43607	*See* SAND–89-2907C			
11	15:43603	*See* LA-UR–90-2236			
12	15:43608	*See* SAND–90-1591C			
13	15:43185	*See* SLAC-PUB–5282			
CONF-9007117–		(SPIE conference on mathematical imaging; San Diego, CA (USA); Jul 1990)			
3	15:43627	*See* LA-UR–90-2358			
CONF-9007125–		(IEEE international vacuum microelectronics conference; Monterey, CA (USA); 23-25 Jul 1990)			
1	15:43225	*See* EGG–10617-1088			
CONF-9007131–		(3. international conference on the structure of surfaces; Milwaukee, WI (USA); 9-12 Jul 1990)			
1	15:42942	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014453	MF-404
CONF-9007133–		(23. international metallographic society annual convention; Cincinnati, OH (USA); 22-25 Jul 1990)			
1	15:42322	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014192	MF-109
2	15:42997	*See* LA-UR–90-2517			
CONF-9007134–		(DARPA workshop on distributed intelligent control systems; Pacifica, CA (USA); 17-19 Jul 1990)			
1	15:43119	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014458	MF-405
CONF-9007135–		(1. international symposium on forest soils; Harbin (China); 22-27 Jul 1990)			
1	15:43287	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013433	
CONF-9007136–		(1990 summer workshop on nonlinear and chaotic phenomena in plasmas, solids, and fluids; Edmonton (Canada); 16-27 Jul 1990)			
1	15:43308	*See* LA-UR–90-2456			
CONF-900723–		(27. IEEE annual international nuclear and space radiation effects conference; Reno, NV (USA); 16-20 Jul 1990)			
13	15:43216	*See* SAND–90-1894C			
CONF-900748–		(20. anomalous absorption conference; Traverse City, MI (USA); 9-13 Jul 1990)			
1	15:43612	*See* UCRL-JC–103616			
CONF-900751–		(6. international conference on valence fluctuations; Rio de Janeiro (Brazil); 9-13 Jul 1990)			
1	15:42994	*See* LA-UR–90-2362			

CONF-900751–

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2	15:42995	*See* LA-UR–90-2363			
CONF-900756–		(SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit; San Diego, CA (USA); 8-13 Jul 1990)			
15	15:43227	*See* LA-UR–90-2321			
17	15:43223	*See* UCRL-JC–104338			
18	15:43222	*See* UCRL-JC–103743			
19	15:43152	*See* LBL–28200			
CONF-900764–		(Fatigue '90 international conference; Honolulu, HI (USA); 15-20 Jul 1990)			
	15:43004	*See* N–90-22117			
CONF-900801–		(25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990)			
	15:42716	*See* N–90-22847			
	15:42835	*See* N–90-21808			
	15:43133	*See* N–90-22606			
23	15:42636	*See* SAND–90-0009C			
CONF-9008125–		(Explomet conference; San Diego, CA (USA); 12-17 Aug 1990)			
1	15:42957	*See* SAND–90-1099C			
CONF-9008127–		(International symposium on industrial tribology; Evanston, IL (USA); 29-31 Aug 1990)			
1	15:43011	*See* SAND–90-0186C			
CONF-900822–		(25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990)			
5	15:43433	*See* FNAL/C–90/104-T			
CONF-900828–		(Summer national meeting of the American Institute of Chemical Engineers; San Diego, CA (USA); 19-22 Aug 1990)			
5	15:42916	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015168	MF-402
CONF-900870–		(10. international symposium on boron, borides and related compounds; Albuquerque, NM (USA); 27-30 Aug 1990)			
2	15:43428	*See* SAND–90-1957C			
CONF-900901–		(World renewable energy congress; Reading (UK); 23-28 Sep 1990)			
2	15:42619	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014449	MF-242
CONF-9009115–		(Spectrum '90: radioactive waste technologies, decontamination, decommissioning and hazardous wastes; Knoxville, TN (USA); 30 Sep - 4 oct 1990)			
1	15:42567	*See* RFP–4398			
CONF-9009192–		(International symposium on discharges and electrical insulation in vacuum; Santa Fe, NM (USA); 17-20 Sep 1990)			
3	15:43604	*See* LA-UR–90-2445			
4	15:43609	*See* SAND–90-1805C			
5	15:43611	*See* SAND–90-1923C			
6	15:43610	*See* SAND–90-1922C			
CONF-9009220–		(12. annual piezoelectric devices conference; Kansas City, MO (USA); 25-27 Sep 1990)			
1	15:43141	*See* SAND–90-1085C			
CONF-9009221–		(6. international symposium on gaseous dielectrics; Knoxville, TN (USA); 23-27 Sep 1990)			
1	15:43183	*See* SAND–90-0732C			
CONF-9009223–		(19. annual North American thermal analysis society conference; Boston, MA (USA); 23-26 Sep 1990)			
1	15:43235	*See* LA-UR–90-2427			
CONF-900958–		(7. annual international Pittsburgh coal conference; Pittsburgh, PA (USA); 10-14 Sep 1990)			
1	15:42328	*See* SAND–90-7021C			
CRN-CPR–89-02	15:43561	NTIS (US Sales Only), PC A09/MF A01		DE90511918	
CTA-IEAv-RI–03/87	15:42734	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90635470	

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CTA-IEAv-RP–					
004/88	15:43562	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634546	
021/88	15:43563	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634547	
028/88	15:43163	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90635440	
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76-45/38	15:43617	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014197	MF-600
76-45/39	15:43618	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014196	MF-600
76-45/40	15:43619	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014200	MF-600
76-45/41	15:43620	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014199	MF-600
DOE/BC/14403–					
T3	15:42344	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014476	MF-122
DOE/BP–					
1311	15:42874	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014148	MF-920
DOE/BP/34906–					
1	15:43134	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014151	MF-920
DOE/BP/35738–					
1	15:42875	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014140	MF-920
DOE/CE/15407–					
T5	15:42876	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014474	MF-350
DOE/CE/15441–					
T2	15:43120	NTIS, PC A03/MF A01 - OSTI		DE90014404	MF-316
DOE/CE/15446–					
T3	15:42351	NTIS, PC A03/MF A01 - OSTI		DE90014475	MF-310
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T4	15:42908	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013317	MF-330
DOE/CE/22122–					
T1	15:42877	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014937	MF-350
DOE/CE/26561–					
1	15:42917	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011123	MF-350
DOE/CE/26572–					
T1	15:42918	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013006	MF-350
DOE/CE/26573–					
T1	15:42919	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011033	MF-350
DOE/CE/34025–					
T4	15:42822	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014377	MF-201
DOE/CE/40865–					
1	15:42911	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014440	PC-311
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T19	15:42912	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014194	PC-310
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20	15:42913	NTIS, PC A25/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014989	MF-313
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124	15:43598	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014666	MF-700
DOE/DP/70041–					
T1	15:42936	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014258	MF-700
DOE/EIA–					
0035(90/04)	15:42863	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90014988	MF-950
0109(90/05)	15:42369	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90015077	MF-950
0130(90/05)	15:42373	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90014506	MF-950
0185(89)	15:42352	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90014685	MF-950
0191(89)	15:42858	NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90014382	MF-950
0226(90/04)	15:42859	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90014991	MF-950
0523(90/1Q)	15:42345	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90015076	MF-950
DOE/ER/13463–					
7	15:43045	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015529	MF-401
DOE/ER/13575–					
4	15:43305	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015065	MF-408
DOE/ER/13778–					
3	15:43420	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014662	MF-411
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3	15:43306	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015388	MF-408
DOE/ER/13814–					
2	15:42323	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014626	MF-401
DOE/ER/13829–					
3	15:43046	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015064	MF-401
DOE/ER/25033–					
3	15:43577	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014627	MF-405

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DOE/ER/30142– T1	15:43178	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014442	MF-406
DOE/ER/40065– 21	15:43432	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014664	MF-414
DOE/ER/40326– 17	15:43488	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015361	MF-413
DOE/ER/40531– 1	15:43469	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015427	MF-413
DOE/ER/45169– T1	15:42943	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014934	MF-404
DOE/ER/45271– T4	15:43564	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014436	MF-411
DOE/ER/45280– 4	15:43565	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015066	MF-410
DOE/ER/45357– 3	15:42971	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014663	MF-404
DOE/ER/53267– 77	15:43586	*See* DOE/ET/53088–438			
DOE/ER/60333– 8	15:43349	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015069	MF-403
DOE/ER/60478– 2	15:43333	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014624	MF-408
DOE/ER/60634– T2	15:43324	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014996	MF-408
DOE/ET/17089– 2854	15:42865	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009665	PC-110
DOE/ET/51013– 286	15:43584	NTIS, PC A11/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015385	MF-426
DOE/ET/53088– 428	15:43585	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015002	MF-421
438	15:43586	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015003	MF-421
439	15:43587	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015185	MF-422
440	15:43355	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015025	MF-420
DOE/FE/00016– T178	15:42335	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015496	MF-116
T179	15:42336	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015319	MF-116
DOE/ID– 10243-2-Vol.2-App.-Pt.2	15:42833	NTIS, PC A22/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014610	MF-331
10289	15:42675	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014734	PC-523
DOE/ID/12784– 1	15:42643	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014438	MF-251
DOE/LC/11049– 2847	15:42384	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009659	PC-123
DOE/LC/11060– 2846	15:42382	NTIS, PC A15/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009656	MF-123
DOE/LLW– 82	15:42536	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015418	MF-510
DOE/MA– 0416P	15:42857	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014737	MF-900
DOE/MC/11076– 2830	15:42383	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000496	MF-123
DOE/MC/24258– T6	15:42660	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014305	MF-105
DOE/METC– 90/6110	15:42332	NTIS, PC A20/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000480	MF-106; MF-111
DOE/NV/10412– 2	15:42645	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014398	MF-251
DOE/OR/21389– 25	15:42624	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015074	MF-247
DOE/PC/70815– T13-Pt.2-Vol.2	15:42338	NTIS, PC A07/MF A01 - OSTI		DE90014420	PC-113
DOE/PC/79669– T2-App.	15:42654	NTIS, PC A16/MF A01 - OSTI		DE90008838	PC-112
DOE/PC/79906– T3	15:42339	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013947	PC-115
DOE/PC/79926– 9	15:42324	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015383	MF-108
10	15:42325	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015384	MF-108

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/88927–					
8	15:42326	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015368	MF-106
DOE/PC/88933–					
6	15:42625	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015369	MF-113
DOE/SF/17960–					
T3	15:42878	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014614	MF-350
DTH-ISVA-PR–					
69	15:42353	NTIS (US Sales Only), PC A05/MF A01		DE90512540	
DTH-LET-RE–					
90-2	15:43248	NTIS (US Sales Only), PC A03/MF A01		DE90512533	
90-1-Vol.1	15:43245	NTIS (US Sales Only), PC A03/MF A01		DE90512530	
90-1-Vol.2	15:43246	NTIS (US Sales Only), PC A08/MF A01		DE90512531	
90-1-Vol.3	15:43247	NTIS (US Sales Only), PC A09/MF A01		DE90512532	
DTH-NI–					
88-09	15:42374	Available on loan from Danmarks Tekniske Bibliotek, Anker Engelundsvej 1, DK-2800 Lyngby			
DTP–					
90-12	15:43456	*See* RAL–90-018			
E–					
4161	15:42814	*See* N–90-21795			
4441	15:42972	*See* N–90-21843			
5205	15:42973	*See* N–90-22421			
5224	15:43113	*See* N–90-21842			
5244	15:42642	*See* N–90-21974			
5262	15:42631	*See* N–90-22488			
5306	15:43003	*See* N–90-21826			
5361	15:42998	*See* N–90-20130			
5391	15:42630	*See* N–90-21812			
5413	15:43006	*See* N–90-22646			
5426	15:43004	*See* N–90-22117			
5443	15:43002	*See* N–90-21824			
5458	15:42835	*See* N–90-21808			
5472	15:42632	*See* N–90-22843			
5492	15:42836	*See* N–90-21844			
5494	15:43133	*See* N–90-22606			
5518	15:42716	*See* N–90-22847			
5524	15:43009	*See* N–90-22822			
ECN-C–					
90-013	15:42866	NTIS (US Sales Only), PC A03/MF A01		DE90509337	
90-017	15:42653	NTIS (US Sales Only), PC A05/MF A01		DE90509315	
90-019	15:42647	NTIS (US Sales Only), PC A04/MF A01		DE90509338	
EGG–					
10617-1088	15:43225	NTIS, PC A - OSTI		DE90014191	MF-706
EPA–					
520/1-89/001	15:43271	*See* PB–90-220492/XAB			
520/1-90/004	15:43266	*See* PB–90-204744/XAB			
600/J-90/005	15:43268	*See* PB–90-217399/XAB			
600/J-90/009	15:43270	*See* PB–90-219718/XAB			
600/J-90/010	15:43269	*See* PB–90-219700/XAB			
600/J-90/037	15:43339	*See* PB–90-217571/XAB			
EPRI-CU–					
6888	15:42834	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EPRI-EL–					
6923	15:42823	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EPRI-GS–					
6905	15:42655	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EUR–					
11398-EN	15:42606	*See* KFK–4721			
FFA-TN–					
1989-31	15:42650	*See* STEV-VIND–90-10			
FNAL-TM–					
1669	15:43180	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014710	PC-406
FNAL/C–					
90/104-T	15:43433	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014985	MF-414
90/122	15:43179	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014986	MF-414
90/134	15:43164	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014984	MF-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
FRCEA-TH–					
273	15:43421	NTIS (US Sales Only), PC A10/MF A01		DE90512025	
FRCR–					
373	15:43586	*See* DOE/ET/53088–438			
FSEC-CR–					
345-90	15:42877	*See* DOE/CE/22122–T1			
FhG-IzfP–					
870406-TW	15:43128	NTIS (US Sales Only), PC A05/MF A01		DE90512995	
GPO–					
23-835	15:42715	Subcommitttee on Energy Research and Development, House of Representatives, Washington, D.C. 20515 HC free			
GSF–					
3/90	15:43249	NTIS (US Sales Only), PC A08/MF A01		DE90512927	
GSI–					
90-10	15:43511	NTIS (US Sales Only), PC A07/MF A01		DE90512915	
90-21(prepr.)	15:43181	NTIS (US Sales Only), PC A03/MF A01		DE90512900	
90-22(prepr.)	15:43448	NTIS (US Sales Only), PC A03/MF A01		DE90512899	
90-23(prepr.)	15:43194	NTIS (US Sales Only), PC A03/MF A01		DE90512923	
90-25(prepr.)	15:43517	NTIS (US Sales Only), PC A02/MF A01		DE90512898	
90-26(prepr.)	15:43518	NTIS (US Sales Only), PC A03/MF A01		DE90512897	
90-27(prepr.)	15:43514	NTIS (US Sales Only), PC A03/MF A01		DE90512896	
HMI-B–					
469	15:43422	NTIS (US Sales Only), PC A03/MF A01		DE90512916	
473	15:43519	NTIS (US Sales Only), PC A05/MF A01		DE90512917	
475	15:43203	NTIS (US Sales Only), PC A03/MF A01		DE90512918	
IAEA-TECDOC–					
550	15:42748	NTIS (US Sales Only), PC A99/MF A01; OSTI; INIS		DE90635307	
IBP-WB–					
45/1989	15:42879	NTIS (US Sales Only), PC A03/MF A01		DE90510164	
IEACR–					
25	15:42333	IEA Coal Research, 10-18 Putney Hill, London SW15 6AA, United Kingdom			
IFSR–					
428	15:43585	*See* DOE/ET/53088–428			
438	15:43586	*See* DOE/ET/53088–438			
439	15:43587	*See* DOE/ET/53088–439			
440	15:43355	*See* DOE/ET/53088–440			
IFT-P–					
09/89	15:43520	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635035	
IFUSP-P–					
764	15:43578	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634408	
765	15:43461	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634433	
772	15:43462	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634434	
775	15:43521	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635036	
777	15:43566	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634538	
782	15:43463	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634435	
785	15:43567	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634548	
788	15:43464	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634436	
805	15:43465	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634437	
IKU-R–					
22.1938.00/01/89	15:42370	NTIS (US Sales Only), PC A04/MF A01		DE90512589	
33.0298.00/02/89	15:42346	NTIS (US Sales Only), PC A04/MF A01		DE90512580	
34.2821.00/01/89	15:42356	NTIS (US Sales Only), PC A03/MF A01		DE90512581	
ILR-Mitt.–					
213(1988)	15:42992	Available from Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt			
INCT–					
2052/5/PS/B	15:42331	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90634521	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
INDC(JPN)–					
140/L	15:43472	*See* JAERI-M–90-099			
INDC(NDS)–					
234	15:43470	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90635061	
INIS-BR–					
2129	15:43480	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90635062	
INIS-mf–					
12627	15:43599	NTIS (US Sales Only), PC A03/MF A01		DE90706119	
12628/V.1	15:43600	NTIS (US Sales Only), PC A04/MF A01		DE90706123	
12628/V.2	15:43601	NTIS (US Sales Only), PC A24/MF A01		DE90706121	
12629	15:43588	NTIS (US Sales Only), PC A03/MF A01		DE90706120	
12630	15:43589	NTIS (US Sales Only), PC A03/MF A01		DE90706122	
INP–					
1343/PS	15:43568	NTIS (US Sales Only), PC A12/MF A01; OSTI; INIS		DE90634553	
1351/PS	15:43423	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634522	
1355/PL	15:43496	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90635081	
1366/PH	15:43434	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634990	
1372/PL	15:43204	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635551	
1373/PL	15:43205	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635552	
1378/E	15:43206	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635556	
1379/AP	15:43288	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90635221	
1386/PL	15:43537	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90635013	
1387/PH	15:43449	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634940	
1392/PL	15:43486	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635067	
1393/PH	15:43538	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635029	
1394/PH	15:43450	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90634924	
1395/PS	15:43424	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634523	
1396/PL	15:43207	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90635600	
1398/PH	15:43435	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90634974	
1399/PL	15:43482	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90635064	
1400/B	15:43260	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635228	
1402/PL	15:43487	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635068	
1410/PH	15:43504	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635089	
1411/PH	15:43539	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635030	
1422/B	15:42774	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635302	
1427/PH	15:43451	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634925	
1428/S	15:43208	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635641	
1431/PL	15:43540	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635031	
1432/PH	15:43436	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634973	
1433/PH	15:43541	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635032	
INPE–					
4938	15:43590	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634635	

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INPE–					
4953	15:43591	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634598	
4958	15:43151	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635425	
INT–					
218/P	15:43602	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634653	
IPNO-DRE–					
89-16	15:43471	NTIS (US Sales Only), PC A03/MF A01		DE90512030	
89-17	15:43437	NTIS (US Sales Only), PC A03/MF A01		DE90512028	
IPNO-TH–					
89-32	15:43452	NTIS (US Sales Only), PC A03/MF A01		DE90512032	
ISH–					
137	15:43334	Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene			
ISI-B–					
31-88	15:43261	NTIS (US Sales Only), PC A05/MF A01		DE90512823	
ISPO–					
310	15:42389	*See* K/ITP–310			
IVL-B–					
950	15:43262	NTIS (US Sales Only), PC A03/MF A01		DE90512613	
955	15:42371	NTIS (US Sales Only), PC A02/MF A01		DE90512639	
981	15:43238	NTIS (US Sales Only), PC A05/MF A01		DE90512646	
982	15:42843	NTIS (US Sales Only), PC A02/MF A01		DE90512638	
IWGGCR–					
18	15:42687	NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS		DE90635511	
IIB-F–					
702	15:42880	Copy held by UB/TIB Hannover			
JAERI-M–					
90-099	15:43472	Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, 319-11, Japan			
JAI–					
331	15:42398	*See* ORNL/Sub–89-SD841/2			
JINR-E–					
14-89-69	15:43307	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90635244	
JINR-R–					
4-89-268	15:43579	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634411	
4-89-384	15:43425	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634524	
Juel–					
2196	15:43484	NTIS (US Sales Only), PC A07/MF A01		DE90513084	
2269	15:43592	NTIS (US Sales Only), PC A06/MF A01		DE90512895	
2300	15:43035	NTIS (US Sales Only), PC A09/MF A01		DE90510283	
2319	15:42951	NTIS (US Sales Only), PC A08/MF A01		DE90512794	
2325	15:42620	NTIS (US Sales Only), PC A08/MF A01		DE90513106	
2338	15:42626	NTIS (US Sales Only), PC A07/MF A01		DE90510281	
Juel-Conf–					
65	15:42539	NTIS (US Sales Only), PC A12/MF A01		DE90512682	
Juel-Spez–					
525	15:43263	NTIS (US Sales Only), PC A05/MF A01		DE90510202	
K/ITP–					
310	15:42389	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013270	MF-515
KBQ-FR–					
1	15:43130	*See* N–90-21165			
KCP–					
613-4276	15:43121	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014755	PC-706
613-4292	15:43226	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014997	MF-706
KFK–					
4589	15:42665	NTIS (US Sales Only), PC A08/MF A01		DE90512716	
4641	15:42733	NTIS (US Sales Only), PC A11/MF A01		DE90512939	
4676	15:42952	NTIS (US Sales Only), PC A04/MF A01		DE90512949	
4684	15:43036	NTIS (US Sales Only), PC A03/MF A01		DE90510179	
4698	15:43264	NTIS (US Sales Only), PC A07/MF A01		DE90510279	
4721	15:42606	NTIS (US Sales Only), PC A03/MF A01		DE90512941	
4730	15:42855	NTIS (US Sales Only), PC A09/MF A01		DE90512940	
KIB-RUB-TWM–					
90-2	15:42993	Available from Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenieurbau			

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KTH-KTR–					
90-10	15:42933	NTIS (US Sales Only), PC A03/MF A01		DE90512632	
KVL-JI-MEDD–					
62	15:43289	NTIS (US Sales Only), PC A06/MF A01		DE90512557	
LA–					
11733-M	15:43290	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014718	PC-900; PC-905
LA-UR–					
90-2236	15:43603	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015102	MF-712
90-2253	15:42556	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015101	MF-700
90-2254	15:42557	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015100	MF-700
90-2258	15:43545	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015098	MF-413
90-2259	15:42607	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015097	MF-700; MF-705
90-2260	15:43626	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015087	MF-705
90-2268	15:43548	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015036	MF-905
90-2271	15:43580	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015035	MF-905
90-2279	15:43546	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015033	MF-413
90-2294	15:43135	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015032	MF-905
90-2321	15:43227	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015027	MF-706
90-2342	15:42608	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014930	MF-700
90-2355	15:43037	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014928	MF-700
90-2357	15:42705	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014927	MF-706
90-2358	15:43627	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014926	MF-905
90-2362	15:42994	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014925	MF-901
90-2363	15:42995	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014924	MF-901
90-2365	15:43357	NTIS, PC A02/MF A01 - OSTI		DE90014923	MF-910
90-2366	15:43358	NTIS, PC A02/MF A01 - OSTI		DE90014922	MF-910
90-2367	15:43359	NTIS, PC A02/MF A01 - OSTI		DE90014921	MF-910
90-2368	15:43360	NTIS, PC A02/MF A01 - OSTI		DE90014920	MF-910
90-2369	15:43361	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014919	MF-910
90-2370	15:43362	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014918	MF-910
90-2372	15:43363	NTIS, PC A02/MF A01 - OSTI		DE90014917	MF-910
90-2373	15:43319	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014916	MF-408
90-2384	15:42558	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014913	MF-704
90-2388	15:43364	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014912	MF-910
90-2404	15:43628	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014910	MF-705
90-2405	15:42706	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014909	
90-2410	15:43129	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014908	MF-700
90-2427	15:43235	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014906	MF-741
90-2431	15:42996	NTIS, PC A03/MF A01 - OSTI		DE90014905	MF-904
90-2433	15:43438	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014904	MF-910
90-2445	15:43604	NTIS, PC A02/MF A01 - OSTI		DE90014902	MF-712
90-2456	15:43308	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014901	MF-905; MF-908
90-2462	15:43454	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014900	MF-414
90-2486	15:42609	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014898	MF-700
90-2487	15:42611	*See* SAND–90-0742C			
90-2517	15:42997	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014694	
90-2530	15:43439	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014695	MF-413
90-2580	15:43571	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014981	MF-910
90-2594	15:43474	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014976	MF-413
LAL–					
89-17	15:43209	NTIS (US Sales Only), PC A07/MF A01		DE90511910	
8939	15:43466	NTIS (US Sales Only), PC A03/MF A01		DE90511905	
8940	15:43459	NTIS (US Sales Only), PC A03/MF A01		DE90511908	
LBL–					
26869	15:42644	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015304	MF-251
28200	15:43152	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015636	MF-414
28426	15:43291	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015305	MF-802
28544	15:43136	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013357	MF-401
28843	15:43137	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014188	MF-406
LIU-TEK-LIC–					
1990-18	15:42914	NTIS (US Sales Only), PC A04/MF A01		DE90512630	
1990-22	15:42881	NTIS (US Sales Only), PC A07/MF A01		DE90512615	
LPS–					
326	15:43161	*See* AD-A–220521/9/XAB			
LPTHE–					
90/11	15:43467	*See* NBI-HE–90-17			
LUNBDS-NBBE–					
1033-1-18-1989	15:43292	NTIS (US Sales Only), PC A03/MF A01		DE90512611	

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LUTFD2-TFRT–					
1032-1-155-1990	15:42824	NTIS (US Sales Only), PC A08/MF A01		DE90512631	
3201-1-103-1989	15:42825	NTIS (US Sales Only), PC A06/MF A01		DE90512590	
5402-1-60-1989	15:42628	NTIS (US Sales Only), PC A04/MF A01		DE90512591	
5409-1-121-1989	15:42656	NTIS (US Sales Only), PC A06/MF A01		DE90512592	
5419-1-63-1989	15:42922	NTIS (US Sales Only), PC A04/MF A01		DE90512593	
LUTMDN-TMVK–					
3135-1-45-1990	15:43125	NTIS (US Sales Only), PC A03/MF A01		DE90512595	
5186-1-14-1990	15:42920	NTIS (US Sales Only), PC A03/MF A01		DE90512594	
5188-1-74-1990	15:42377	NTIS (US Sales Only), PC A04/MF A01		DE90512596	
LYCEN-T–					
87-69	15:43426	NTIS (US Sales Only), PC A06/MF A01		DE90511916	
MISC–					
90024-Vol.2-App.-Pt.2	15:42833	*See* DOE/ID–10243-2-Vol.2-App.-Pt.2			
MLM–					
3639	15:43038	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014735	PC-701
N–					
90-20130	15:42998	NTIS, PC A03/MF A01			
90-21165	15:43130	NTIS, PC A11/MF A02			
90-21795	15:42814	NTIS, PC A09/MF A02			
90-21808	15:42835	NTIS, PC A02/MF A01			
90-21812	15:42630	NTIS, PC A02/MF A01			
90-21817	15:42999	NTIS, PC A09/MF A02			
90-21824	15:43002	NTIS, PC A03/MF A01			
90-21826	15:43003	NTIS, PC A03/MF A01			
90-21836	15:42953	NTIS, PC A03/MF A01			
90-21842	15:43113	NTIS, PC A03/MF A01			
90-21843	15:42972	NTIS, PC A03/MF A01			
90-21844	15:42836	NTIS, PC A02/MF A01			
90-21974	15:42642	NTIS, PC A03/MF A01			
90-22022	15:43114	NTIS, PC A10/MF A02			
90-22030	15:43138	NTIS, PC A03/MF A01			
90-22031	15:43139	NTIS, PC A04/MF A01			
90-22117	15:43004	NTIS, PC A02/MF A01			
90-22371	15:43365	NTIS, PC A01/MF A01			
90-22402	15:43366	NTIS, PC A03/MF A01			
90-22409	15:43005	NTIS, PC A11/MF A02			
90-22421	15:42973	NTIS, PC A02/MF A01			
90-22467	15:43367	NTIS, PC A03/MF A01			
90-22479	15:43370	NTIS, PC A05/MF A01			
90-22488	15:42631	NTIS, PC A03/MF A01			
90-22522	15:43371	NTIS, PC A01/MF A01			
90-22526	15:43372	NTIS, PC A03/MF A01			
90-22606	15:43133	NTIS, PC A02/MF A01			
90-22646	15:43006	NTIS, PC A03/MF A01			
90-22651	15:43007	NTIS, PC A17/MF A03			
90-22767	15:43008	NTIS, PC A03/MF A01; 1 functional color page			
90-22822	15:43009	NTIS, PC A03/MF A01			
90-22834	15:42639	NTIS, PC A15/MF A02; 1 functional color page			
90-22835	15:42867	NTIS, PC A03/MF A01			
90-22843	15:42632	NTIS, PC A02/MF A01			
90-22847	15:42716	NTIS, PC A03/MF A01			
90-22918	15:43228	NTIS, PC A99/MF A04			
NAS–					
1.15:100397	15:42953	*See* N–90-21836			
1.15:100398	15:43372	*See* N–90-22526			
1.15:101280	15:43365	*See* N–90-22371			
1.15:102436	15:42973	*See* N–90-22421			
1.15:102443	15:43113	*See* N–90-21842			
1.15:102457	15:42642	*See* N–90-21974			
1.15:102475	15:42631	*See* N–90-22488			
1.15:102549	15:42998	*See* N–90-20130			
1.15:102569	15:42630	*See* N–90-21812			
1.15:102570	15:42972	*See* N–90-21843			
1.15:103095	15:43006	*See* N–90-22646			
1.15:103098	15:43003	*See* N–90-21826			
1.15:103102	15:43004	*See* N–90-22117			
1.15:103119	15:43002	*See* N–90-21824			
1.15:103128	15:42835	*See* N–90-21808			
1.15:103133	15:42632	*See* N–90-22843			
1.15:103140	15:42836	*See* N–90-21844			

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1.15:103142	15:43133	*See* N–90–22606			
1.15:103156	15:42716	*See* N–90–22847			
1.15:103157	15:43009	*See* N–90–22822			
1.26:179862	15:43366	*See* N–90–22402			
1.26:180413	15:43005	*See* N–90–22409			
1.26:180482	15:43008	*See* N–90–22767			
1.26:180650	15:42867	*See* N–90–22835			
1.26:182607	15:43007	*See* N–90–22651			
1.26:185095	15:43139	*See* N–90–22031			
1.26:185173	15:42639	*See* N–90–22834			
1.26:185203	15:43130	*See* N–90–21165			
1.26:185218	15:43114	*See* N–90–22022			
1.26:186002	15:43367	*See* N–90–22467			
1.26:186442	15:43138	*See* N–90–22030			
1.26:186478	15:42999	*See* N–90–21817			
1.26:186563	15:43370	*See* N–90–22479			
1.26:186578	15:43371	*See* N–90–22522			
1.55:10016	15:42814	*See* N–90–21795			
1.55:10032	15:43228	*See* N–90–22918			
NASA-CP–					
10016	15:42814	*See* N–90–21795			
10032	15:43228	*See* N–90–22918			
NASA-CR–					
179862	15:43366	*See* N–90–22402			
180413	15:43005	*See* N–90–22409			
180482	15:43008	*See* N–90–22767			
180650	15:42867	*See* N–90–22835			
182607	15:43007	*See* N–90–22651			
185095	15:43139	*See* N–90–22031			
185173	15:42639	*See* N–90–22834			
185203	15:43130	*See* N–90–21165			
185218	15:43114	*See* N–90–22022			
186002	15:43367	*See* N–90–22467			
186442	15:43138	*See* N–90–22030			
186478	15:42999	*See* N–90–21817			
186563	15:43370	*See* N–90–22479			
186578	15:43371	*See* N–90–22522			
NASA-TM–					
100397	15:42953	*See* N–90–21836			
100398	15:43372	*See* N–90–22526			
101280	15:43365	*See* N–90–22371			
102436	15:42973	*See* N–90–22421			
102443	15:43113	*See* N–90–21842			
102457	15:42642	*See* N–90–21974			
102475	15:42631	*See* N–90–22488			
102549	15:42998	*See* N–90–20130			
102569	15:42630	*See* N–90–21812			
102570	15:42972	*See* N–90–21843			
103095	15:43006	*See* N–90–22646			
103098	15:43003	*See* N–90–21826			
103102	15:43004	*See* N–90–22117			
103119	15:43002	*See* N–90–21824			
103128	15:42835	*See* N–90–21808			
103133	15:42632	*See* N–90–22843			
103140	15:42836	*See* N–90–21844			
103142	15:43133	*See* N–90–22606			
103156	15:42716	*See* N–90–22847			
103157	15:43009	*See* N–90–22822			
NBI-HE–					
90-17	15:43467	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634438	
90-18	15:43455	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90634907	
90-20	15:43468	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90634439	
NEANDC(J)–					
153/U	15:43472	*See* JAERI-M–90-099			
NEI-SE–					
59	15:42661	NTIS (US Sales Only), PC A05/MF A01		DE90512612	
NIKHEF-K-LINO–					
1990-1	15:43182	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90635452	

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NISTIR–					
4339	15:42826	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014221	MF-220
NOVEM–					
90-318	15:42888	*See* TNO-TPD–814.017			
90-379	15:42873	*See* CHRI-RVG–5860-1			
90-389	15:42886	*See* TNO-HMT–90-044			
90-390	15:42887	*See* TNO-HMT–90-045			
NRL-MR–					
6612	15:43583	*See* AD-A–220768/6/XAB			
NRRI–					
90-9	15:42860	OSTI; National Regulatory Research Institute, 1080 Carmack Road, Columbus, Ohio 43210		TI90014361	
90-10	15:42861	OSTI; National Regulatory Research Institute, 1080 Carmack Rd., Columbus, OH 43210		TI90014360	
NUREG–					
0540-Vol.12-No.3	15:42717	NTIS, PC A19/MF A01 - GPO; OSTI; INIS		TI90014570	
0540-Vol.12-No.4	15:42718	NTIS, PC A14/MF A01 - GPO; OSTI; INIS		TI90014505	
0540-Vol.12-No.5	15:42719	NTIS, PC A18/MF A01 - GPO; OSTI; INIS		TI90014929	
0750-Vol.31-No.5	15:42720	NTIS, PC A06/MF A01 - GPO; OSTI; INIS		TI90014470	
0936-Vol.9-No.2	15:42775	NTIS, PC A08/MF A01 - GPO - OSTI		TI90015478	
1377-Rev.1	15:42735	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI90015171	
1425	15:42669	NTIS, PC A18/MF A01 - GPO; OSTI; INIS		TI90014612	
NUREG/CR–					
2000-Vol.9-No.6	15:42721	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI90014907	
4794	15:42776	NTIS, PC A17/MF A01 - GPO; OSTI; INIS		TI90015004	
5532	15:42559	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI90015023	
NUREG/IA–					
0034	15:42777	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI90015024	
OEFZS-A–					
1682	15:42616	Available from the Austrian Research Centre Seibersdorf, A-2444 Seibersdorf (Austria)			
ORNL–					
6608/R5	15:42845	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014760	MF-630
6612	15:42923	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014759	MF-332
6613	15:43299	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014758	MF-403
6617	15:42327	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014757	MF-101
6619	15:43239	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014785	PC-908
6629/P1	15:42657	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014765	MF-114
ORNL/CON–					
301	15:42848	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014771	MF-310
ORNL/DSRD–					
25	15:43629	NTIS, PC A16/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014794	MF-405
ORNL/FTR–					
3651	15:42882	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013391	MF-350
3652	15:42883	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013398	MF-350
3658	15:42849	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014016	MF-350
3660	15:42847	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014314	MF-270; MF-247; MF-225; MF-241
3675	15:42974	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014299	MF-332
3677	15:42975	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014321	MF-332
3678	15:42954	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014992	MF-404
3681	15:43309	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015138	MF-408
3682	15:43211	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014569	MF-406
3691	15:42955	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015137	MF-404
3692	15:42778	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014983	MF-505
3694	15:43265	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015378	MF-402
ORNL/NSIC–					
200-Vol.9-No.6	15:42721	*See* NUREG/CR–2000-Vol.9-No.6			
ORNL/NSP–					
90/4	15:42856	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014619	MF-500
ORNL/Sub–					
64-00221/1	15:42924	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014770	MF-332
89-SD841/2	15:42398	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014786	PC-812; PC-513
ORNL/TM–					
11134	15:42740	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014787	PC-530
11349	15:43631	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014780	MF-405
11460	15:43300	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014779	MF-402
11480	15:43605	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014788	PC-420

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11513	15:42707	NTIS, PC A22/MF A01 - OSTI		DE90014793	MF-523
11523	15:43593	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014789	PC-426
11531	15:43212	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014776	MF-413
11558	15:43606	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014791	PC-426
11559	15:43632	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014792	PC-420
11566	15:43633	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014774	MF-405
11577	15:43047	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014773	MF-401
11579	15:43634	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014772	MF-405
11590	15:42934	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014741	MF-334
9987	15:43630	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014782	MF-405
PATENTS-USA–					
4905756/A/	15:42970	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4906095/A/	15:43232	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4906917/A/	15:43029	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4910877/A/	15:43230	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4912051/A/	15:43043	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4912355/A/	15:43231	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4912421/A/	15:43193	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4913807/A/	15:43229	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4913891/A/	15:43317	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4914024/A/	15:42330	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4914063/A/	15:43091	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4914215/A/	15:43332	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4914793/A/	15:43124	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4914818/A/	15:42828	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4915500/A/	15:43224	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4917447/A/	15:43148	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4917784/A/	15:43095	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4917825/A/	15:43042	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4917830/A/	15:43123	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4918624/A/	15:43647	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4918711/A/	15:42987	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4920994/A/	15:42659	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4921765/A/	15:42868	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4921952/A/	15:43322	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4922203/A/	15:43331	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
4923020/A/	15:42366	Patent and Trademark Office, Box 9, Washington, DC 20232 (USA)			
PB–					
90-123126	15:43005	*See* N–90-22409			
90-204744/XAB	15:43266	NTIS, PC A06/MF A01			
90-214388/XAB	15:42846	NTIS, PC A11/MF A02			
90-216391/XAB	15:43267	NTIS, PC A02/MF A01			
90-217399/XAB	15:43268	NTIS, PC A03/MF A01			
90-217571/XAB	15:43339	NTIS, PC A02/MF A01			
90-219700/XAB	15:43269	NTIS, PC A02/MF A01			

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90-219718/XAB	15:43270	NTIS, PC A02/MF A01			
90-220492/XAB	15:43271	NTIS, PC A07/MF A01			
90-221953/XAB	15:43272	NTIS, PC A02/MF A01			
90-591330/XAB	15:43340	NTISStanding Order			
90-591340/XAB	15:43341	NTISStanding Order			
90-591630/XAB	15:43342	NTISSubscription			
90-780438/XAB	15:43343	NTISCP D01			
90-871260/XAB	15:42935	NTISPC N01/MF N01			
90-872300/XAB	15:43273	NTISPC N01/MF N01			
PFC/RR–					
90-11	15:43584	*See* DOE/ET/51013–286			
PNL–					
7385	15:42884	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014298	MF-350
7396	15:43301	NTIS, PC A10/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015556	MF-502
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89-1	15:43457	Also published in Nucl. Phys., A (30 Oct 1989) v. 503(3/4) p. 865-884			

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DE90009665	DOE/ET/17089-2854
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US United States of America (USA)
UY Uruguay

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